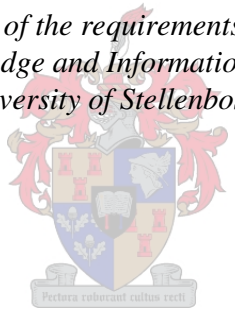
Knowledge assets in enterprise architecture

by
Francois Joubert

Thesis presented in fulfilment of the requirements for the degree Master in Philosophy (Knowledge and Information Management) at the University of Stellenbosch



Supervisor: Mr Daniel F Botha
Faculty of Arts and Social Sciences
Department of Information Science

December 2010

Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained herein is my own, original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated) and that I have not previously submitted it for obtaining any qualification.

22 NOVEMBER 2010

Abstract

Knowledge assets can be defined as anything that affects a business's disposition to act on data received from the environment. Knowledge assets are embedded in the objects within an organisation and are the source of an organisation's competitive advantage, by being closely linked to what the organisation knows and by allowing the organisation to act and to be innovative.

Knowledge assets evolve over time as knowledge agents, through a process of sense making, substitute physical resources for informational resources by codifying and abstracting knowledge assets, in the process increasing their value and ability to be diffused to wider audiences. These knowledge assets are internalised in an organisation and impact on the organisation when they are applied to concrete problems.

Knowledge assets play an important role in the creation of information assets in an organisation. Information assets are created when a knowledge agent makes use of his or her knowledge to make sense of data received from sources in the environment. The creation of information through the sense making process creates new knowledge which is added to the agent's knowledge base.

Enterprise architecture is the process of designing future states for an organisation and then planning, leading and governing the organisation towards that future state. Enterprise architecture focuses mostly on the organisational process, on information and technology. Enterprise architects make use of enterprise architecture frameworks such as TOGAF or the Zachman framework, which are primarily concerned with the domains of business, information and technology architecture, yet none of these mainstream frameworks used by enterprise architects takes knowledge assets into account, despite the obviously important role that they play in the organisation and especially in the information creation process.

This research proposes to show that knowledge assets have an important role to play in enterprise architecture by allowing enterprise architects to

- identify or facilitate the creation of knowledge assets pertaining to a specific problem;
- understand whether information assets are located in the ordered and complex or the chaotic regimes and what would be the implication of moving them between regimes;

- plot knowledge assets movements and relationships to each other on the social learning cycle path, which would enable enterprise architects to balance the types of learning that the organisation employs;
- define the level of codification, abstraction and diffusion of knowledge assets, based on the intended audiences and to understand where knowledge assets could be developed to improve quality and when outdated knowledge should be destroyed in favour of new knowledge.

Knowledge assets are related to Enterprise Business Architecture (EBA) through the specific knowledge domains that exist within an organisation. Understanding whether knowledge assets exist in the ordered, complex or chaotic regimes will provide a more complete view of the organisation. Architecture of knowledge assets in this space will provide a better understanding of an organisation's culture: this understanding can compensate for differences in knowledge agents' spatio-temporal positions, how and when they receive data and their particular cognitive styles.

The importance of knowledge assets in the creation of information links it emphatically with Enterprise Information Architecture (EIA). Knowledge asset architecture provides a better understanding of how information is created and flows through an organisation, taking into account the meaning of the information to the organisation, which compensates for that oversight in information theory, which regards the accuracy of data that is communicated as the only concern.

Information technology has exponentially increased mankind's ability to codify, abstract and diffuse knowledge assets. Enterprise Technical Architecture (ETA) is mainly concerned with the technology infrastructure implemented within an organisation. Enterprise architects can apply knowledge asset architecture to decide whether the technology should be used to enhance the codification and abstraction of information, allowing more efficient diffusion of information to a larger audience, or whether more concrete information should be diffused to a more closely-knit audience.

This research will argue that the use of knowledge assets as a domain within enterprise architecture will greatly enhance the enterprise architect's ability to understand and lead the organisation to a more desirable future state.

Opsomming

Kennisbates is vasgelê in die konkrete en abstrakte voorwerpe in die organisasie. Hierdie voorwerpe omsluit alle voorwerpe wat ‘n effek het op hoe die organisasie reageer op data wat vanaf die omgewing ontvang word. Kennisbates is ‘n bron vir die kompeterende voordeel wat ‘n organisasie geniet omdat dit verband hou met wat die organisasie weet en dit die organisasie in staat stel om te innoveer.

Kennisbates sal aangaande evolueer soos wat kennisdraers, deur die sinmaak proses, fisiese hulpbronne vervang met inligtings hulpbronne gedurende die proses van kodifisering en abstraksie en sodoende die kennisbates se waarde vir die organisasie te verhoog en beskikbaar te stel vir groter gehore. Die kennisbates word dan vasgelê in die organisasie wanneer die kennis toegepas word op konkrete probleme.

Kennisbates speel ‘n belangrike rol in die skepping van inligtingsbates in die organisasie. Inligting word slegs geskep wanneer die kennisdraer gebruik maak van sy kennis om sin te maak van data onvang vanuit die omgewing. Die nuwe inligting word dan intern vasgelê in die kennisdraer as nuwe kennis.

Ondernemingsargitektuur is ‘n proses waardeur die toekomstige staat van ‘n organisasie ontwerp word deur beplanning, en daar verder leiding gegee word ter uitvoering daarvan. Ondernemingsargitektuur fokus meestal op die organisasie se prosesse, inligting en tegnologie. Ondernemingsargitekte maak gebruik van ondernemingsargitektuurraamwerke soos TOGAF en die Zachmanraamwerk as riglyne vir hulle werk. Hierdie raamwerke fokus primêr op die besigheid, inligting en tegniese domeine van argitektuur. Nie een van die hoofstroom ondernemingsargitektuurraamwerke neem kennisbates in ag nie, ten spyte van die voordiehandliggende belangrike rol wat kennisbates in die organisasie se inligtingskeppingsproses speel.

Hierdie navorsing stel voor dat kennisbates deel kan vorm van ondernemingsargitektuur deur ondernemingsargitekte toe te laat om

- kennisbates aangaande ‘n spesifieke probleem te identifiseer of die skepping daarvan die fasiliteer,

- te bepaal of die kennisbates in die geordende, komplekse of chaotiese regime bestaan en wat die implikasie sou wees om hulle na ‘n ander regime te skuif, en
- die kennisbates op die sosiale leersiklus aan te stip, wat die ondernemingsargitek in staat sal stel om die leerbenaderings van die organisasie te balanseer, die vlak van kodifisering, abstraksie en verspreiding te definieer, gebaseer op die voornemende gehoor vir die spesifieke inligting.
- beter begrip te hê daarvoor of die kennisbate na ‘n beter kwaliteit ontwikkel moet word of vernietig moet word om plek te maak vir nuwe kennisbates.

Daar bestaan ‘n verwantskap tussen OBA (Ondernemingsbesigheidsargitektuur) deur die spesifieke kennisdomein wat reeds in die organisasie bestaan. Deur te verstaan of die kennisbates binne die geordende, komplekse of chaotiese regimes val sal beter begrip bied van die organisasie as geheel. Al hierdie gesigshoeke word in die geordende domein beskryf. Kennisbateargitektuur sal ‘n beter begrip van die organisasie se kultuur bewerkstellig. Die kultuur in ‘n organisasie word gebruik om te vergoed vir die verskille in die kennisdraer se tyd-ruimtelike ligging tydens die ontvangs van data asook hulle kognitiewe styl.

Daar bestaan ‘n daadwerklike verwantskap tussen kennisbateargitektuur en Ondernemingsinligtingsargitektuur (OIA). Kennisbateargitektuur sal bydra tot die begrip van hoe inligting geskep word en vloei deur die organisasie. Dit sal die betekenis van inligting in ag neem en daardeur vergoed vir die tekortkoming van inligtingteorie wat slegs die korrektheid van die data wat vervoer word in ag neem.

Inligtingstegnologie het die mens se vermoë om inligting te kodifiseer, abstraksie toe te pas en te versprei eksponensieël verbeter. Ondernemingstegnieseargitektuur (OTA) is hoofsaaklik verantwoordelik vir die tegnologiese infrastruktuur wat geïmplimenteer word binne die organisasie. Ondernemingsargitekte kan kennisbates gebruik om te besluit of tegnologie gebruik moet word om beter inligting te skep deur hoër kodifisering en abstraksie toe te pas, om daardeur die vermoë te skep om die inligting vir ‘n wyer gehoor beskikbaar te stel, of om meer konkrete inligting vir ‘n meer intieme gehoor beskikbaar te stel.

Hierdie navorsing stel voor dat kennisbates as ‘n domein binne die ondernemingsargitektuur vervat word. Dit sal die ondernemingsargitek in staat stel om die organisasie beter te lei na ‘n wenslike toekomstige staat.

Acknowledgements

This work is dedicated to my lovely wife Elmarié and my most beautiful daughters Amelia and Ilze. They gave so much more than mere support. The cost in family time for completing this kind of work is astronomical and without their sacrifices it would have been impossible.

To my parents and grandmother: it is your lifelong support and encouragement that have encouraged me to strive towards this achievement.

To all those friends, colleagues and family who helped to make me feel guilty by constantly asking me about my progress with the thesis: your interest has been a real motivation.

Special thanks to my supervisor Mr Daan Botha, who sometimes needed to prod me into action. Your faith in my abilities and constant support and advice has been indispensable.

To my Creator, who gave me the ability to do this. Thank you!

> *And I propose the hypothesis that all major trends of change constituting our new, confusing world are related and that we can make sense of their interrelationship.*
>
> Manuel Castells, *The Rise of the Network Society*

List of abbreviations

ADM	Architecture Development Method
ANSI	American National Standards Institute
BI	Business Intelligence
CRM	Customer Relationship Management
DoDAF	Department of Defence Architecture Framework
EBA	Enterprise Business Architecture
EIA	Enterprise Information Architecture
ERP	Enterprise Resource Planning
ETA	Enterprise Technical Architecture
HR	Human Resources
IEEE	Institute of Electrical and Electronics Engineers
IT	Information Technology
MoDAF	Ministry of Defence Architecture Framework
SCM	Supply Chain Management
SLC	Social Learning Cycle
TAFIM	Technical Architecture Framework for Information Management
TOGAF	The Open Group Architecture Framework

List of figures

Table of contents

Chapter 1

Introduction

1.1 Background

1.1.1 Information complexity

Recording, sharing, processing and using information have long been an important factor in the development of the human race. Our ancestors created art against the walls of caves to record the stories of their communities. The mark of early civilisations like the Egyptians was their ability to record hieroglyphic depictions of their daily life against their buildings and tombs.

Gradually humanity's need and ability to deal with complex information increased. Fang[1] identifies six *Information Revolutions,* ranging from writing, printing, mass media, and communication to the Internet, showing natural progression in human thinking and the use of technologies to increase our capacity to deal with more complex information.

Each revolution made use of advances in technology that

- transformed the way information was distributed
- dramatically increased the amount of information and its dissemination to more people, and
- made the communication of information more interactive.

A consequence of this technological advance and high concentration of information is that data-processing agents[2] (individuals, firms, organisations or even whole industries) are constantly attempting to find ways to economise on their data processing. The reason for this

---

[1] Fang. 1997

[2] Boisot. 1998, p15

is that we as individuals, society and civilisation have now become smothered in *data smog*[3], all in the name of advancement and making life better for ourselves.

Boisot[4] mentions that the information revolution *promises gains in our data processing capacities* which should lead to *considerable savings in the consumption of physical resources per unit of output* but he is sceptical about the possible positive effect that the reduced consumption of physical resources will have on the environment. Economised consumption of physical resources will have little effect if humans continue to *increase output and expectations* due to demand created by *uncontrolled population growth* and *rising expectations*. We will still be required to make the hard choices and meet our expectations and demands from resources that will increasingly be below their carrying capacity.

He goes further to write that

> *…the substitution of data for physical resources cannot go on for ever either. We cannot eat data nor can we keep ourselves warm by standing in front of a computer simulation of a log fire. Some irreducible level of physical resources is necessary to the maintenance of life. More importantly, perhaps, we cannot begin coherently to process all the data that the information revolution is immersing us in. Our brains are finite and our rationality is therefore bounded. Where we confront data in volumes that exceed our capacity to process it, we either ignore it – i.e., sub-optimise – or suffer some kind of breakdown, overwhelmed by the complexity of it all.*

People have long since fantasised about this problem that our generation is about to face. The novella *The machine stops*[5] by E.M Forster (1909) paints a sombre picture of the world, where mankind becomes totally dependent on technology. Long before the invention of these technologies he describes concepts that have become commonplace in today's world, for example television, referred to as a *cinemataphote*. He refers to virtual communities being created, where people communicate in groups or peer to peer, using technology that we today know as video conferencing. He describes how people's only means of contact is the exchange of information through the use of technology and how they became completely

---

[3] Edmunds and Morris. 2000

[4] Boisot. 1998, p28

[5] Forster. 1909

reliant on *The Machine* for their survival. Meanwhile, the environment in this futuristic world has been all but destroyed by the demands that the human race has made from the environment. Catastrophe follows when technology fails them and they have to face the harsh realities of the world they have created.

This depiction might be overly pessimistic, but one needs to consider how much closer we are to these realities than we were 100 years ago when this novella was first published. It is in the light of this that we come to realise why we need to invest so many of our resources just to process all the data into which our environment has immersed us.

1.1.2 Enterprise Architecture

Information Technology Systems enable organisations to deal with the masses of data that they need to manage in order to be successful. Many solutions specialising in solving different problems have been created over time. Some common types include Enterprise Resource Planning (ERP)[6], Customer Relationship Management (CRM)[7], Supply Chain Management (SCM)[8] and Business Intelligence (BI) [9] to name but a few.

One of the most prominent themes in describing the above-mentioned solutions is the complexity[10] involved when implementing them in an organisation. The complexity to an organisation increases with each new solution that is implemented, due to the demand that it places on the organisation to process more data within its IT systems and data-processing agents.

Ross et al. appropriately quote Albert Einstein when discussing the complexity issue, where he said:

> *The significant problems we face cannot be solved by the same level of thinking that created them.* [11]

Ross et al. add the following:

---

[6] Umble, Haft and Umble. 2003, Soh, Kien and Tay-Yap. 2000, Markus, Tanis and Fenema. 2000

[7] Payne and Frow. 2005, Peppard. 2000

[8] Harland. 1996, Cooper, Lambert and Pagh. 1997

[9] Watson and Wixom. 2007, Jourdan, Rainer and Marshall. 2008

[10] Complex is defined as a group of obviously related units of which the degree and nature of the relationship is imperfectly known
Source: Merriam-Webster Online,Merriam-Webster. 2009a

[11] Ross, Weill and Robertson. 2006, p viii

> *In 1995 we started our study in Enterprise Architecture, we just didn't know it – at the time we thought we were studying information technology infrastructure transformations. In 1998 we thought we were studying Enterprise Systems Implementations. In 2000 it was e-business. But some time in 2000 we recognised that each of these studies examined basically the same thing: Enterprise Architecture.* [12]

Schekkerman[13] writes that

> *…Enterprise Architecture is a* ***complete*** *expression of the enterprise. A master plan, which* ***acts as a collaboration force*** *between aspects of business planning such as goals, visions, strategies and governance principles.*

He defines Enterprise Architecture as "… *providing a mechanism that enables communication about the essential elements and functioning of the enterprise"*.

It is clear from this that Enterprise Architecture is a discipline that unites an organisation by designing future states for the organisation, where the disparate components are more integrated, links and relationships more robust and alignment to objectives and compliance requirements is ensured. It is intended to help an organisation cope with the complexities that it faces.

Based on the above, Enterprise Architecture can be described as a discipline that allows organisations to economise on their data processing on all levels (within the system domain and within the human domain) by dealing with complexity in the organisation through its holistic and encompassing role.

It can also be said that complexity exists mainly as a result of the exponential increase in data processing requirements, brought on by the information revolution, and that one of the main roles of the Enterprise architect will be to facilitate communication or information flow between the elements within an organisation.

1.1.3 Information and Complexity

Quantum Information Theory according to Boisot et al. is

---

[12] Ross et al. 2006, p vii

[13] Schekkerman. 2003, p13

> *…broader in scope than classical information theory, (and) operates at the most abstract level, quite removed from any social science conception of information.* [14]

Yet when the applicability of this quantum view of information in a social context is questioned Boisot et al. write:

> *The distinction that we are drawing between data, information and knowledge is implicit in the work being done in the Physics of Information.* [15]

In classical information theory, the ***bit*** is the *fundamental unit of analysis*. A bit can have two possible end states, represented by an 0 or a 1 and can be likened to a switch that is either On or Off.

In quantum information theory, according to Boisot et al, the ***qubit*** becomes the *fundamental unit of analysis*. The qubit has two possible *Eigenstates* |0> or |1> and differs from the bit in the sense that

- a qubit can also be in any well-defined linear combination of the two Eigenstates
- unlike a bit, whose state can be examined without destroying it, a qubit's Eigenstates are not available as data to be analysed because the current state is destroyed by analysis. Measuring any qubit will reduce it to one of its Eigenstates.

When attempting to determine the amount of information that can be held within a qubit, it becomes clear that much information can be tied up and hidden within one qubit and that a group of qubits will increase the amount of encapsulated information exponentially.

With Quantum Information Theory we have to abandon the assumption that we can distinguish between different states. The *orthogonality* between two qubit states cannot be maintained or even distinguished and recorded as data. This lack of data inhibits the ability to extract reliable information concerning the states.

Boisot et al. then state that

> *…there are physical limits to our access to data, hence our ability to extract information from data.* [16]

---

[14] Boisot, MacMillan and Han. 2008, p31
[15] Boisot et al. 2008, p31
[16] Boisot et al. 2008, p32

Classical information theory as proposed by Shannon[17] is concerned with the accurate transmission of the message and not the meaning of the message. Modern information technology systems are built on this principle, since they interact with data at the bit level, but ignore the qubit that contains the potential for meaning that can lead to information.

From this we can deduce that Enterprise Architecture as a discipline is also mostly interested in the interaction with data at the bit or accuracy level, potentially leaving a gap where the extraction of information from data occurs.

1.1.4 Knowledge assets

Boisot[18] defines

- **data** as a discernible difference between alternative states of a system. It is made up of low energy that acts informationally rather than mechanically upon the observer
- **information** as data that modifies the expectations or conditional readiness of the observer. The more the expectations are modified, the more informative the data is said to be
- **knowledge** is the set of expectations that an observer holds with respect to an event. It is a disposition to act in a particular way that has to be inferred from behaviour rather than the observer directly.
- **knowledge assets** can be thought of as that subset of dispositions to act that is embedded in the individuals, groups or artefacts that have value-adding potential.

From this it can be seen why information is an important resource for organisations. It is possible for some data existing inside or outside an IT system to surprise people inside the organisation; this in turn has the potential to change people's expectations, which can influence the way people act by having a direct influence on the agility and sustainability of the organisation.

It is then reasonable to argue that Knowledge Assets can play an important role in understanding the meaning and expectations that organisational information has. It is also

---

[17] Shannon. 2001

[18] Boisot. 1998, p19

reasonable to argue that by including knowledge asset architecture into the way one views enterprise architecture, it allows one ways to deal with

- complexity issues that can be found in organisational information
- the emergent properties of information and knowledge, and
- the limitations encountered when extracting information from data.

This implies then that certain questions regarding knowledge assets and enterprise architecture need to be answered.

1.2 Research questions

This research focuses on answering the following questions:

- Can knowledge assets be architected?
- What is the relationship between Knowledge Asset Architecture and the other domains of Enterprise Architecture namely Business Architecture, Information Architecture and Technical Architecture?

1.3 Hypothesis

If Knowledge Asset Architecture relates significantly to Business, Information and Technical Architecture, it will form an integral part of management dynamics in deriving value from information assets.

1.4 Research overview

Chapter 2 provides an overview of the research methodology used for this research and the reasons why this particular research methodology was followed.

Chapter 3 discusses the state of the practice of enterprise architecture. It examines the role of the Enterprise Architecture as an extension of the organisation's strategy. It also surveys some common Enterprise Architecture frameworks and the role they play as tools in developing an organisation's enterprise architecture. Lastly, it explores the general domains that form part of Enterprise Architecture. These domains are broadly defined as Enterprise Business Architecture (EBA), Enterprise Information Architecture (EIA) and Enterprise Technical Architecture (ETA).

Chapter 4 explores the domain of knowledge assets as defined by Boisot[19]. In particular it looks at the interaction between Data, Information and Knowledge and discusses the reasons why Knowledge can be described as assets within the organisation. This chapter explores the dynamics of knowledge assets in terms of:

- the lifecycle of knowledge and how it flows from chaotic systems, through complex systems into ordered systems and back into chaos,
- the process of sense making as knowledge creation,
- the dynamics of knowledge assets in terms of level of *codification, abstraction and diffusion*
- the epistemological orientation of knowledge assets and how it relates to possible, probable and plausible knowledge, and
- how knowledge flows within the organisation.

Chapter 5 explores how the Enterprise architect can incorporate knowledge assets into the development of the Enterprise Architecture, mainly by understanding knowledge assets as an embedded dimension in the objects and artefacts that can be found in the enterprise architecture of an organisation.

[19] Boisot. 1998

Chapter 2

Research Methodology

This thesis is a formal report on research about the role that Knowledge Management could or should play in the field of Enterprise Architecture. The audience for this research thus includes not only academics performing research in the above mentioned fields, but also practitioners of the two disciplines in the industry, typically managers and executives who manage informational resources in the organisation, such as the Chief Information Officer (CIO).

According to Booth, Colomb and Williams[20] *doing research is all about finding a problem for which the answer can be found by doing research*. A research problem usually has it roots in topics and problems from everyday life to which solutions need to be investigated and verified.

2.1 Research Topic

Booth et al. suggest that researchers should find research problems that are familiar to them and that would be of significance to a specific community.

Experience shows that practicing Enterprise Architects tacitly take into account the role of knowledge in the organisation, but little evidence could be found in formal methods like The Open Group Architecture Framework (TOGAF) and other frameworks to formally support the concepts of Knowledge Management and Knowledge Assets. It is from this observation that the research topic, which explores the role that Knowledge Assets plays in the practice of Enterprise Architecture was derived.

2.2 Research Questions

Research topics should be focused by asking research questions. Booth et al.[22] write that

> *If a writer asks no specific question worth asking, he can offer no specific answer*

---

[20] Booth, Colomb and Williams. 2008, p41

> *worth supporting. And without an answer to support, he cannot select from all the data he could find on a topic, just those relevant to his answer.*

After finding a question, Booth, Colomb and Williams, suggest that questions should be evaluated for their significance to the field of study.

In the case of this research, the questions stated in Chapter 1 are meant to explore the possible integration of what has up to now been seen as two different disciplines. Information Technology Architecture has, as will be shown in Chapter 3, been mainly focused on the transfer of information, one byte at a time, with the emphasis on whether all bytes have been transferred reliably and not whether the informational value was realised during transfer.

Introducing knowledge assets as a way of looking at Enterprise Architecture will introduce the meaning of data into the equation. This is a significant shift from the traditional Enterprise Architecture approach.

2.3 Sources for research

According to Booth, Colomb & Williams three types of sources can be distinguished when doing research:

- Primary sources, which provide raw data that used to first test the working hypothesis and then as evidence to support your claim.
- Secondary sources, which typically include research reports that use primary data to solve problems, written for scholarly and professional audiences.
- Tertiary sources, which are books and articles that synthesise and report on secondary sources for general readers.

The primary data for this research is based on data obtained from literature. The purpose of this research is the discovery of relationships between the practice of Enterprise Architecture and the theory of Knowledge Assets. Primary data has been gathered from literature sources describing:

- the practice and the state of the art of Enterprise Architecture. In this section use has been made of practical frameworks like TOGAF[21] and Zachman[22] to explore the scope of the discipline and to point out certain shortcomings in the current thinking;
- the theory of knowledge assets, which includes sources that describes Sense making by Karl Weick[23], social theory by Manuel Castells[24] and the dynamics of knowledge assets and information by Boisot et al.[25]

Secondary sources have been used in the case of this research to form certain of the arguments, and to discover some of the relationships between the main subjects. Works from Shannon[26], Fang[27] and March[28], to name but a few, have been instrumental in supporting some the arguments and elaborations that forms part of this research.

Tertiary sources include making use of the on-line versions of the Webster and Oxford dictionaries to clarify meaning and align semantic differences where needed. Use has also been made of the on-line Encyclopaedia Britannica to provide some contextual information. Articles by the Gartner research organisation were instrumental in exploring some of the practical and industry-related topics, especially regarding the practice of Enterprise Architecture.

---

[21] Harrison. 2007
[22] Zachman. 2008b
[23] Weick. 1995
[24] Castells. 2003b
[25] Boisot et al. 2008
[26] Shannon. 2001
[27] Fang. 1997
[28] March. 1994

Chapter 3

Enterprise Architecture

3.1 The role of Enterprise Architecture

Enterprise Architecture is seen as a process of designing future states of an organisation and then planning, leading and governing the organisation towards that future state.

Originally, Information Systems Architecture was meant to design optimal future states for IT solutions in terms of technology, applications and data. With the increasing importance of *information as a source of a competitive advantage*[29] it has become more important to drive the Information Technology landscape as a strategic initiative with a view to having systems available that could assist the organisation to achieve its strategic goals and objectives, rather than by aligning the information systems to the strategy. Pavlak[30] sees the definition of the role of enterprise architecture as a vehicle to align IT systems with strategy as a narrowly defined one. He believes that enterprise architecture should play a *more broadly scoped role* in defining the fundamental structure of the enterprise.

Pavlak sees the value proposition of enterprise architecture as having three *roots* that embody the narrow and wider value proposition. These roots with their respective values are:

- **IT improvement**, which provides value in the planning the future state of IT system implementation that is geared towards creating more efficient IT systems that work well within the organisation,
- **Enterprise transformation**, which will leverage the architecture that is embedded in the structural relationship between IT and business processes to optimise the organisation's processes, resulting in large gains in productivity and efficiency.
- **Strategic vision**, which is no longer the domain of the business strategist who sets the direction to which IT systems need to adjust. The important role of IT in an organisation

---

[29] Porter and Millar. 1985

[30] Pavlak. 2006

means that strategic vision needs to be determined in conjunction with IT planning, effectively positioning enterprise architecture as an extension of organisational strategy.

Gartner researcher Burton strongly echoes these sentiments by stating that

> *…enterprise architecture is about ensuring that an organization has the right integration/alignment between IT and the business (including people, processes, investments, information and technology) in order to better support the business's capabilities, and to enable the business to evolve toward a future state. Senior executives should be looking to EA to help change the business in order to reduce risk and inefficiencies as well as to increase effectiveness, business impact, responsiveness and business opportunity.* [31]

She goes further by stating that enterprise architecture is a **strategic planning process**, which is part of organizational overall strategic planning efforts and that enterprise architects facilitate the process to define a **future state** for the enterprise (requirements, principles and models) so that they can identify gaps between that future state and today's capabilities. The link to strategy is reiterated by her statement that

> *…EA is an essential part of and supports the enterprise's overall strategic planning efforts (business strategy, IT strategic planning, EA, governance, portfolio management, scenario planning and so on), and as such, it is of real value and impact only when used in conjunction with these other disciplines.* [32]

Organisations can only show profit and value when the actions that are performed in the organisation by employees endow products and services with a value proposition for which customers are willing to pay. Knowledge, according to Boisot[33], is what places an agent at a specific disposition to act a certain way. Certain kinds of knowledge that can be embedded in individuals, groups or artefacts are assets to the organisation, as they have the potential of disposing the organisational resources to act in such a way that their actions can add value. This knowledge is called *knowledge assets* because it can be used to generate profits for the organisation. When this knowledge is the exclusive property of the organisation it is known as intellectual property.

---

[31] Burton. 2009, p3
[32] Burton. 2009, p6
[33] Boisot. 1998

It is thus essential that enterprise architecture as a holistic and strategic process takes into account not only the management of information from an information technology perspective, but also that the dynamic nature of data, information and knowledge needs be given the highest priority in the architecture of the organisation:

> *Data, information and knowledge are distinct kinds of economic goods, each possessing a specific type of utility. The utility of data resides in the fact that it can carry information about the physical world; that of information, in the fact that it can modify an expectation or a state of knowledge; finally, that of knowledge in the fact that it allows an agent to act in adaptive ways in and upon the physical world.*[34]

Information and knowledge are closely coupled and mutually affect each other, and the fact that information and data architecture are core to the development of enterprise architecture, is why this research explores the relationship between enterprise architecture and knowledge assets.

3.2 Enterprise Architecture frameworks

Architecture, as used in the context of Enterprise Architecture according to the ANSI/IEEE Std 1471-2000, is

> *…the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.*[35]

Enterprise Architects usually make use of *Enterprise Architecture Frameworks* to navigate the complexities of organisations. These frameworks consist of *generic processes*, *domains*, *reference models* and *methods* to assist the enterprise architect to understand the internal and external environments of all organisational levels. Organisations that need to have high levels of control at a very granular level are the pioneers of *Enterprise Architecture Frameworks*. The earliest forms of enterprise architecture frameworks were primarily developed by military organisations like the US Department of Defence who developed *Technical Architecture Framework for Information Management* (TAFIM) and later developed the

---

[34] Boisot and Canals. 2008, p20

[35] Harrison. 2007, p15

Department of Defence Architecture Framework (DoDAF) and the British Ministry of Defence, which is responsible for the *Ministry of Defence Architecture Framework* (MODAF). Other pioneers include people like *John Zachman* whose matrix framework is probably the most widely used framework in the Enterprise Architecture domain. One of the most complete, generic and widely accepted frameworks is The Open Group Architecture Framework (TOGAF) which is the product of experience gained based on several enterprise architecture frameworks and the efforts of many international work groups.

3.2.1 The Open Group Architectural Framework

TOGAF provides a state-of-the-art framework for performing enterprise architecture in the organisation. TOGAF[36] consists of three main parts:

- The TOGAF Architecture Development Method (ADM), which provides a process based view of enterprise architecture that describes a method for developing an enterprise architecture, and forms the core of TOGAF
- The TOGAF continuum, which describes the different types and scopes of the architecture artefacts and assets that can be derived from it, and leveraged during its use.
- The TOGAF resource base, which provides guidance on several architectural concepts like patterns, templates, guidelines, building blocks, governance and architectural views, to name but a few.

The TOGAF ADM represents the core of what an architect is required to do. Figure 3-1 is a graphical representation of the different phases of the ADM.

[36] Harrison. 2007

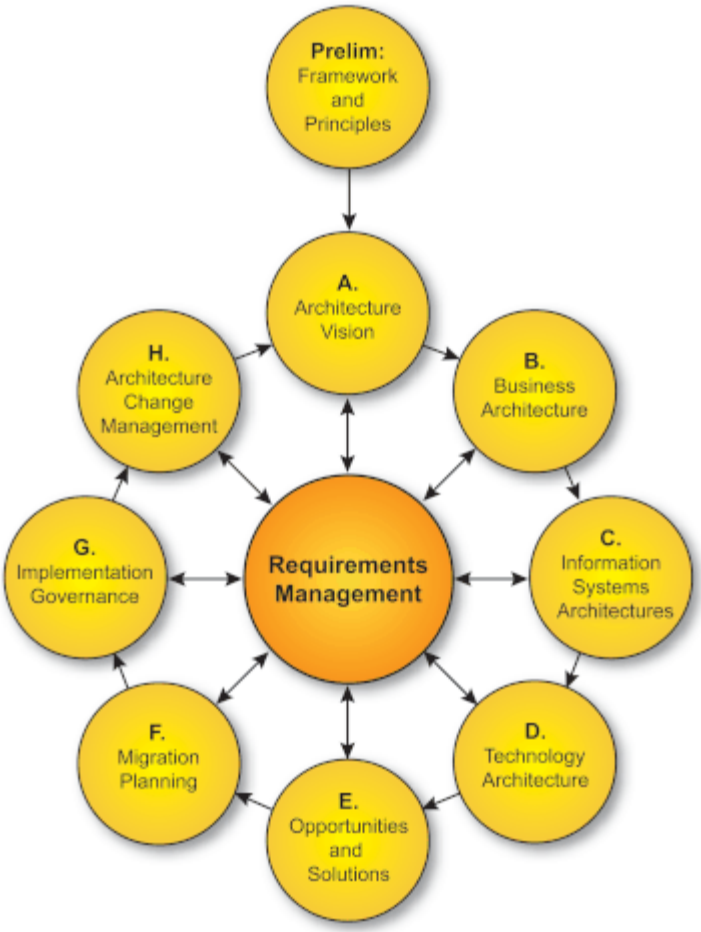


Figure 3-1 Phases of the TOGAF ADM

(Source: Harrison, 2006)

The TOGAF ADM represents a process that contains inputs, activities and outputs which can be applied to the practice of enterprise architecture. The phases of TOGAF are:

- The Preliminary Phase, which is about defining "*how we do architecture*" in the enterprise concerned. There are two main aspects: defining the framework to be used; and defining the architecture principles that will inform any architecture work.
- The Architecture vision, Phase A, which is about ensuring proper recognition and endorsement from corporate management, and the support and commitment of line management. It also defines what is in and what is outside the scope of the architecture effort and the constraints that must be dealt with.
- Phase B business architecture, which is used to gain knowledge of the business architecture before work can be commenced on the other types of architecture. This is necessary as a means of demonstrating the business value of subsequent Technical

Architecture work to key stakeholders, and the return on investment to those stakeholders from supporting and participating in the subsequent work.

- Phase C, which has as its objective the development of Target Architectures, covering either or both (depending on project scope) of the Data and Application Systems domains.
- Phase D, which is aimed developing a Technology Architecture that will form the basis of the following implementation work.
- Phase E, or opportunities and solutions, which identify the parameters of change, the major phases along the way, and the top-level projects to be undertaken in moving from the current environment to the target.
- Phase F, which is aimed at migration planning and is used for sorting the various implementation projects into priority order. Activities include assessing the dependencies, costs, and benefits of the various migration projects. The prioritized list of projects will go on to form the basis of the detailed Implementation Plan and Migration Plan.
- Phase G, implementation governance, which formulates recommendations for each implementation project, construct an Architecture Contract to govern the overall implementation and deployment process, perform appropriate governance functions while the system is being implemented and deployed, and ensure conformance with the defined architecture by implementation and other projects.
- Phase H, architecture change management, which aims to establish an architecture change management process for the new enterprise architecture baseline that is achieved on completion of Phase G; this process will typically provide for the continual monitoring of such things as new developments in technology and changes in the business environment, and for determining whether to formally initiate a new architecture evolution cycle.
- Architecture requirements management, which defines the process whereby the requirements for enterprise architecture are identified, stored, and fed into and out of the relevant ADM phases.

3.3 Enterprise architecture domains

Most enterprise architecture frameworks group the architectural components into enterprise domains. These domains generally consist of business, data, application and technology domains. Some frameworks combine the data and application domains into an information systems domain, while other also includes a domain for information architecture as well.

No specific convention exists on how to divide the enterprise into domains, in fact several other domains groupings have been proposed. Iyer and Gottlieb[37] proposed a four-domain architecture that suggests the following domains:

- **A process** domain that includes the processes, procedures, business tools, tasks that encode business rules, and dependencies required to support the various functions within a business
- **An information/knowledge** domain that includes business rules and business data and information of all types, their usage, interrelationships and demographics, as well as their definitions, ownership, distribution, and composition
- **An infrastructure** domain that includes hardware and facilities, system software, data storage resources, networks and communications, human interfaces, and other underlying technologies.
- **An organization** domain that includes business people and their roles and responsibilities, organizational structures and boundaries, as well as their interrelationships to alliances, partnerships, customers, suppliers, and other stakeholders in the enterprise.

The Zachman framework[38] on the other hand makes use of a matrix structure to represent different views on the organisation. The first dimension makes use of the fundamentals of communication found in the primitive interrogatives[39]:

[37] Iyer and Gottlieb. 2004
[38] Zachman. n.d.
[39] Zachman. 2008a

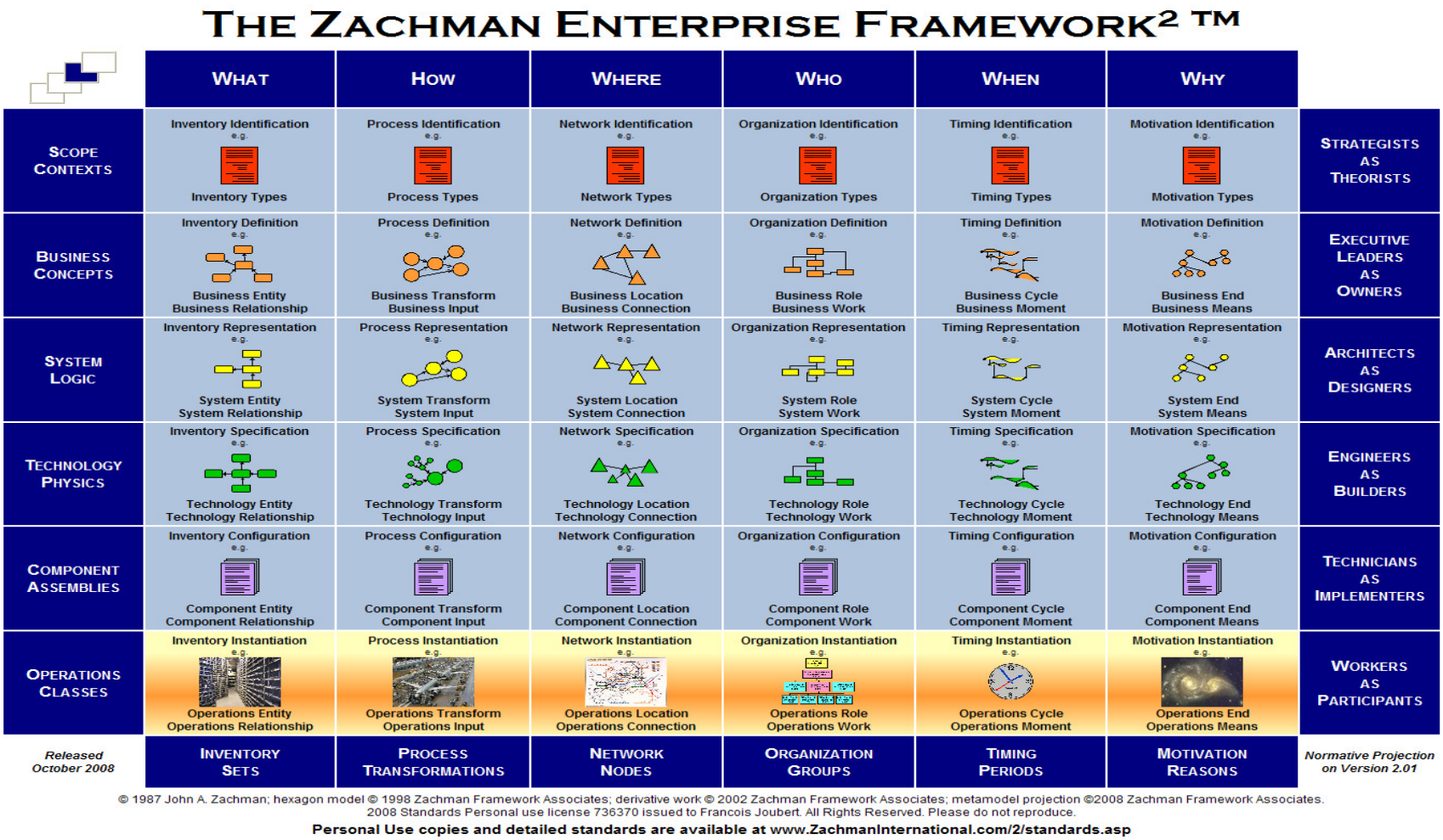


Figure 3-2 The Zachman Enterprise Framework

(Source: Zachman 2008)

- The data perspective asks the question, **what**? and represents things that are important to the organisation,
- The functional perspective asks the question, **how**? and represents the processes that are performed in the organisation,
- The network perspective asks the question, **where**? and represents the locations where the organisation operates,
- The people perspective asks the question **who**? and represents the people and organisations important to the organisation,
- The time perspective asks the question **when**? and represents events and cycles that are important to the organisation
- The motivation perspective asks the question **why**? and represents the reason why the organisation exists in terms of its objectives and goals embedded in its strategy

The second dimension that intersects with the first set has six perspectives:

- The planner perspective that is concerned with the scope of the organisation and provides context to the architecture,
- The owner perspective, concerned with the business model that is used in the organisation and provides a conceptual perspective,
- The designer perspective, concerned with the systems (not limited to information technology) that operates in the organisation and provides a logical perspective to the architecture,
- The builder perspective, concerned with the technology used in the organisation and provides a physical perspective on the organisation,
- The subcontractor perspective, concerned with the detail representations of the organisation so that it can be taken out of context and build as per perspective, and
- The user perspective, concerned with the operational perspective of the organisation and provides and implementation view of the organisation.

Urbaczecwki and Mrdalj[40] mentions that DoDAF builds on three sets of views: Operational, System, and Technical standards. A fourth view, All View, augments the other views by providing the linkage between the other views

The TOGAF[41] provides for

- a business view,
- an information systems view, which includes a data and applications perspective, and
- a technology view.

Organisations are in essence complex constructs, which are generally difficult to comprehend. Enterprise architecture frameworks are attempts to create views or perspectives on these complex entities in an effort to create more manageable chunks to comprehend. All the architecture frameworks discussed above make use of views or perspectives to deal with the complexity of the organisation. The views might not be the same, but they all attempt to cover the complete enterprise.

It is important to note that enterprises are holistic entities and cannot be segmented into separate domains that can be dealt with separately. The enterprise architecture domains merely provide different views or perspectives on the organisation to guide the architecture process. Each domain strongly influences the other domains through a set of complex relationships and interactions. It is for this reason that there are no right or wrong answers when defining architectural views or domains. Two factors can *inter alia* be considered as important when deciding which set of views to use:

- Ensuring that the views cover the complete enterprise, and
- Ensuring that the views chosen are appropriate for the organisation and the problems that need to be solved.

Newman et al.[42] defines three primary viewpoints that form part of Enterprise Architecture. These viewpoints are *Enterprise Business Architecture*, *Enterprise Information Architecture* and *Enterprise Technical Architecture*. Each viewpoint includes multiple levels of abstraction and specificity.

---

[40] Urbaczewski and Mrdalj. 2006
[41] Harrison. 2007
[42] Newman, Gall and Lapkin. 2008

3.3.1 Enterprise Business Architecture

Enterprise Business Architecture (EBA) is concerned with designing and guiding the business towards an optimal future state.

EBA, according to Burton[43], concerns itself with people, financials, organizational structure and process. These dimensions are likely to be influenced by compliance, the extended enterprise ecosystem, organizational culture and politics, innovation, behaviours, time, industry, and region/location.

The TOGAF ADM[44] has a somewhat different, yet complementary, view of what the Business Architecture encompasses. The following items are required by the TOGAF ADM:

- Organization structure – for identifying business locations and relating them to organizational units
- Business goals and objectives – for the enterprise and each organizational unit
- Business functions – a detailed, recursive step involving successive decomposition of major functional areas into sub-functions
- Business services – the services that the enterprise and each enterprise unit provide to its customers, both internally and externally
- Business processes, that include measures and deliverables
- Business roles, that include the development and modification of skills requirements
- Business data model, and
- Correlation of organization and functions, that relates business functions to organizational units in the form of a matrix report.

The TOGAF ADM does not explicitly consider financials as a dimension, nor does it provide guidance on the factors influencing the business architecture that Burton mentions. However, Enterprise Architecture practitioners tacitly know that it is important to take these items, and possibly more depending on the business environment, into account.

---

[43] Burton. 2008, p6

[44] Harrison. 2007, p61-72

Enterprise Architecture evolved from the need to design, build and implement technology and solutions to match the business requirements. Information Technology has had a fundamental influence on the way organisations operate and is embedded in the way in which business is conducted, that it has become imperative for organisations to react proactively on matters related to managing organisational information and knowledge. It is generally accepted that any change in the technology or information landscape fundamentally affects the organisation. As a result, a constant state of tension and flux exists between the elements within the organisation, resulting in elevated levels of complexity.

Burton emphasises the need for Enterprise Business Architecture to influence and change the business world when she writes as follows:

> *EBA needs to define the current state, and the actions and changes (for example, gap analysis and governance) that need to be made to process, financials, people and organizational structures to reach that future state.* [45]

EBA is linked emphatically to business strategy when Burton states the following:

> *EBA translates **upstream** business vision and strategy by leveraging common requirements from the business context into contextual-, conceptual-, logical- and implementation-level requirements for EBA.* [46]

Burton states that EBA is more than designing processes or gathering requirements from the business. She writes that this implies that,

> *EBA must equally consider people, financials, process and organizational structure, not just processes primarily and certainly not processes in isolation* and further that *EBA is not the business context* and *as with an information, technology and solution architecture, the EBA is derived from the business context and should demonstrate clear traceability of architectural decisions to the elements of the business strategy*. [47]

Designing and planning the organisation is not the exclusive function of the enterprise architecture initiative. The ADM of TOGAF states that

---

[45] Burton. 2008, p4
[46] Burton. 2008, p4
[47] Burton. 2008, p5

> *in some cases, key elements of the Business Architecture may be done in other activities; for example, the enterprise mission, vision, strategy, and goals may be documented as part of some wider business strategy or enterprise planning activity that has its own lifecycle within the enterprise.*[48]

EBA thus exists not only to better understand the core of business processes, strategy, vision and products and services, but also to guide and provide input to the organisation on possible improvements, efficiencies and ways to enhance business agility and resilience.

It is important to understand that although EBA might be applied in various business areas, it should be seen as an activity in the enterprise architecture process that should dove-tail with the rest of the enterprise architecture.

Also important to note is the fact that EBA would not be seen as one of the domains of enterprise architecture if the expectation had been that it could only provide input and direction to the other domains of the architecture. The dimensions of the EBA domain will be affected by the architecture process by analyzing the current state of the business, defining a desirable future state and driving towards that desirable state. EBA should, in addition to providing input to the other domains, be influenced by the information and technical domains.

3.3.2 Enterprise Information Architecture

Gartner defines Enterprise Information Architecture (EIA) as

> *that part of the enterprise architecture process that describes — through a set of requirements, principles and models — the current state, future state, and guidance necessary to flexibly share and exchange information assets to achieve effective enterprise change.*[49]

All organisations are fundamentally affected by what has become known as the Information Age. Internally organisations have acquired and implemented myriad systems that support different functions. Different kinds of applications like ERP (Enterprise Resource Planning), CRM (Customer Relationship management), workforce and HR (Human Resources),

---

[48] Harrison. 2007, p62

[49] Newman et al. 2008, p2

financial applications and many more have been implemented in organisations addressing problems through a technological approach.

Even though these systems did enable organisations to move forward, often despite many problems related to lack of change management and business architecture issues, they have also created many problems of their own, mainly due to the complex nature of the organisation within which the systems were implemented. These problems can be viewed on many different levels, ranging from problems of a technical nature to those of a business nature.

A common example of a technical level is the information pockets that were created when these systems were implemented in isolation. There was no global plan for exchanging information among systems to ensure that data needed by more than one system was consistently stored and shared amongst these systems. This led to bad data quality, due to the fact that different results were obtained, depending on which system was queried.

The same problem can be expressed as a business level problem, as the confusion that is created by consumers of information when conflicting messages are received due to information inconsistencies. This leads to problems when making decisions and creates unnecessary conflict and tension within the organisation. As observed by Newman et al.:

> *EIA **requirements** generally state how specific information will flow among groups inside and outside the enterprise, and the integration guidelines between customers, partners or suppliers. Similarly, additional requirements govern the quality, timeliness, security and accessibility of key information assets*[50]

Sample EIA models often include the development of shared data models to achieve consistency or reuse objectives or project jump-starts. Models would also include business process and information requirements from a conceptual level of detail through the logical design of services and components. These models would then influence the roles of service, component or application designers, integration specialists and workflow managers regarding the physical implementation aspects of the EIA.

It is generally unclear what exactly constitutes enterprise information and what the scope of information within the Enterprise Architecture context is. It is for this reason that several of

---

[50] Newman et al. 2008, p3

the enterprise architecture frameworks omit the information domain altogether or incorporate it within the business or data view of the organisation.

Newman et al. write that,

> *….it is important to clarify that information assets be defined as those assets expressed in some digitized structure (as distinguished from knowledge management, which addresses knowledge or information in tacit or unexpressed forms).* [51]

An explicit reason for limiting the Enterprise Information Architecture exercise to digitised information is not provided, but the assumption is made that it is to control the scope of the EIA effort by limiting the sphere of influence to the tangible and coded area of information. Newman et al.'s definition also assumes that information is merely expressed knowledge. They go further to explain that,

> *…..a key challenge to EIA is that digitized information exists in multiple and inconsistent formats and structures (ranging from structured to semi-structured to unstructured information assets), which limits the ability to access, share and exchange information. Architects need to recognize that there is no one-size-fits-all blueprint or model that will resolve all semantic differences.* [52]

The scope of the EIA initiative is also curbed by the following statement of Newman et al:

> *A common misconception is that the scope of enterprise information architecture is **all** information in the enterprise. Although true at an abstract level, in reality, the focus of EIA is on information assets that are deemed to have enterprise significance and that are necessary to achieve effective business change.* [53]

They also add that a,

> *….scoping distinction lets architects avoid trying to architect **all** information in the enterprise, or the **boiling the ocean** syndrome. Ultimately the primary scope of EIA, then, is on sharing information to enhance flexibility.* [54]

---

[51] Newman et al. 2008, p3
[52] Newman et al. 2008, p3
[53] Newman et al. 2008, p4
[54] Newman et al. 2008, p4

There is no question that the amount of information that can be associated with the organisation will seem infinite and any design and architecture exercise that does not limit its scope in some way will most definitely need unlimited budget and time. There is thus merit in focusing on information that supports the strategy of the organisation to enable effective change.

Limiting the architecture exercise to digitised information only will severely constrain the value and effectiveness of the EIA initiative. All levels and types of the enterprise's information should be included in the Enterprise Architecture initiative, given that the scope of enterprise architecture extends across the enterprise and is essentially an extension of the enterprise's strategy[55]. Within any specific context information exists on different levels and in different degrees of complexity. Considering only the less complex digitised information will be short-sighted, as only a diminutive set of the potential information assets will be part of the architecture exercise.

At some point, all information was complex and un-digitised. Business owners and IT practitioners, driven by business needs, decided to digitise certain information sets, based on assessments of their criticality and maturity for storing in a digital format. The Enterprise Architecture function is ideally situated to make decisions regarding organisational information and knowledge from a holistic perspective and should consider information and knowledge in all shapes and forms to understand its context and value within the organisation.

Information from an academic perspective only has value in the context of the agent or observer for which it is information. Boisot refers to,

> *….information as data that changes the observer's expectations or conditional readiness and that this conditional readiness or set of expectations regarding data is what is known as knowledge*[56]

He further argues that knowledge is what gives the information processing agent a *disposition to act* and that this set of expectations and dispositions to act is known as the *agent's knowledge assets*. It is impossible to determine the informational value of a data set without understanding the knowledge assets of the observer/agent, and also to understand that the

---

[55] Pavlak. 2006

[56] Boisot. 1998, p20

more valuable the information, the more it will change the knowledge set of the processing agent.

Information creation in organisations can occur on different levels depending on the type of system within which the information is created. Kurtz and Snowden[57] identify three types of systems:

- In an *ordered* system, like an IT system or set of IT systems, it is possible to exchange data between entities based on a specifically programmed set of rules. Data received by a system will trigger a response from that system that might include actions to update a matching data set, trigger a process or alert or even to ignore the message, due to the fact that it has no relevance. In the case of intelligent systems the message might even cause the system to change its set of conditions on how to react to new messages. This description conforms to the definition of information in terms of the system's change of expectations – the new status communicated by the message will now be stored as a datum in the database.
- In a *complex* system, like a group of humans, the message travels interactively between systems and humans and in even more complex circumstances, between human and human or human group. The information creation in these cases is generally non-linear and the responses most likely to be unpredictable. Yet the process remains constant because new messages will trigger a wider range of responses but invariably also change the knowledge processing agent's conditional readiness or disposition to act.
- In a *chaotic* system there is no relationship between cause and effect. There is nothing to analyze; and waiting for patterns to emerge is a waste of time. The chaotic domain is in a very real sense uncanny, in that there is a potential for order but few can see it— or if they can, they rarely do unless they have the courage to act. The types of problems that are addressed through enterprise architecture are never in a permanent state of chaos. These systems however laps into a chaotic state due to a significant event and the elements within the system's inability to cope with the event.

So even though it is information that has value to the organisation or individual is it always the knowledge assets that determine the extent of the information value.

---

[57] Kurtz and Snowden. 2003

3.3.3 Enterprise Technical Architecture

Munsh[58] defines Enterprise Technical Architecture (ETA) as *the process of providing an optimally configured mix of hardware and software technology to enable enterprise IT solutions*. The enterprise network is the key component of the enterprise technical infrastructure. The application infrastructure includes supporting hardware (servers, storage systems, and client PCs) and associated system software, such as the database and the operating system.

Enterprise Architecture originally stems from the technical architecture domain, and focuses mainly on application, data, and hardware and network infrastructure. An example of the evolution from technical architecture to enterprise architecture can be found where Zachman[59] shows that his framework evolved from an *Information Systems Architecture Framework* in 1987 (see Figure 3-3) to the complete *Enterprise Architecture Framework* that we know today (see Figure 3-2).

[58] Munsh. 2002

[59] Zachman. 2009

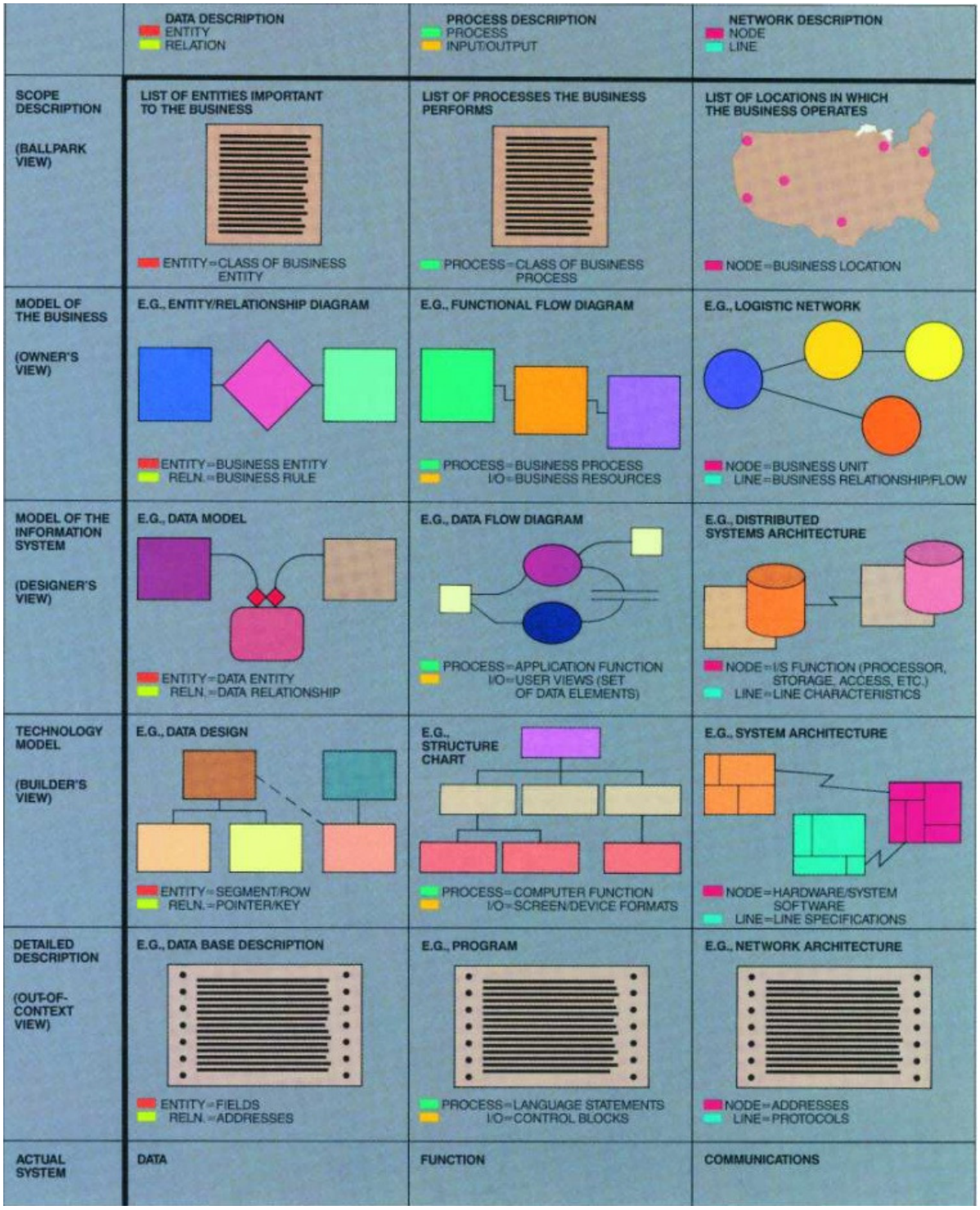


Figure 3-3: Framework for information systems Architecture

(Source: Zachman, 1987)

Zachman notes that the earlier version has only three columns. While all six columns did actually exist with the earlier version, Zachman felt that people might not be able to fully appreciate (or be willing to accept) his thoughts, particularly since Enterprise Architecture hadn't been born yet and this was a Framework for *Information Systems* architecture.

Enterprise Technical Architecture needs to be guided and driven by the organisation's business and information architecture for it to deliver value to the organisation. It is often a problem amongst Enterprise Architecture teams to focus mostly on Technical Architecture. This tendency can cause problems for Enterprise Architecture, as the focus is on building infrastructure and not on delivering solutions. Robertson strongly advises organisations not to concentrate on Enterprise Technical Architecture only, but to have a balanced and comprehensive view of Business and Information Architecture [60]. Technology Architecture is ineffective without linkage to business strategy, process and information needs. It solves a few small problems in IT supply without solving big problems in IT demand. The other Enterprise Architecture work clarifies the real reasons and value for any Enterprise Technical Architecture work. Focusing on Technology Architecture results in technology for technology's sake, and distances the IT from the business. An exclusive focus on Enterprise Technical Architecture is often the result of the following factors:

- Enterprise Architecture initiatives that are often led by individuals with primarily technical backgrounds; EA teams led by individuals with wider experience often avoid the trap of leading with technology;
- Stakeholder concerns not being defined; no stakeholders (except perhaps those inside IT) want infrastructure like Enterprise Service Buses or networks. What they want is the solutions that leverage that infrastructure. To clarify this, you need business architecture issues (process, people, and financial issues) and information architecture issues (data, data flow, data integration) defined. By restricting stakeholders, issues can become purely technical;
- A lack of business buy-in; the business stakeholders need to be involved in the Enterprise Architecture initiative and this takes time and effort. The results of the Enterprise Architecture effort will not have the desired outcome in the business if buy-in was not obtained.

Enterprise Technology Architecture provides the core technology and infrastructure to enable the organisation to derive strategic value from its information assets. The way to accomplish this is to ensure that the direction of the technology architecture synergises with the

[60] Robertson. 2008, p2

organisation as a whole by enabling and supporting the requirements and direction put in place by the complete enterprise architecture effort.

3.4 Enterprise architecture as a change agent

Enterprise architecture plays an important role as a change agent for realising an organisation's strategic goals and objectives. Enterprise architecture frameworks compensate for the complexities which exist in organisations by defining views or perspectives to describe and understand organisations. These views are then used as reference points to design a future state of the organisation which would better align with the organisational objectives and goals.

Solutions which typically enable organisational change primarily focus on solving problems in the business, information and technical domains of the organisation. Typical enablers involve solutions that provide processes, information management services and technology aimed at providing the means for the organisation to realise its strategy.

Most mainstream enterprise architecture frameworks do not take the role of organisational knowledge into account. There is no doubt however that knowledge plays an important role in the organisation. The question that needs to be answered is whether there is a place for knowledge as a domain in the enterprise architecture.

The following chapter studies the role of knowledge assets in the organisation and establishes it as an important factor in the mechanics of the organisation. The use of knowledge assets as a way to deal with the complexity of the organisation and to better understand the role of emergent strategy and architecture is also explored.

Chapter 4

Knowledge assets

4.1 Defining Knowledge Assets

Most large organisations today have some form of Knowledge Management initiative; these are usually supported from a strategic perspective by the board, mainly because it is difficult to properly define deliverables and objectives for KM projects. As a result the definition of this knowledge that is being managed seems to vary vastly and is hounded by inconsistencies.

One of the earliest definitions for knowledge was proposed by Plato and is also the definition used by Nonaka et al.[61], who define knowledge as *justified true belief*. Nonaka et al. also state that knowledge is not a set of static beliefs but rather a *dynamic entity, since it facilitates interaction between people*.

The Oxford dictionary[62] defines knowledge as,

> *…..information and skills acquired through experience or education.*

The Merriam-Webster online dictionary[63] defines it as,

> *….the fact or condition of knowing something with familiarity gained through experience or association* - an alternative definition defines it as *the range of one's information or understanding.*

Stacey provides a definition of what knowledge is not, when he writes that,

> *….knowledge is not a **thing**, or a system, but an ephemeral, active process of relating.*[64]

---

[61] Nonaka, Toyama and Konno. 2000, p7
[62] Oxford Dictionary. 2009
[63] Merriam-Webster. 2009b
[64] Stacey. 2001, p4

Stacey iterates that no one, not even a corporation, can own knowledge. He said that knowledge itself cannot be stored, nor can intellectual capital be measured, and certainly neither of them can be managed.

Steward avoids the issue when he writes in a footnote that,

> *….it has become traditional in books about knowledge and knowledge management to spend several pages defining knowledge and distinguishing it from data, information and sometimes wisdom. I feel no need to inflict any such rumination on you, dear reader; dictionaries and common usage are good enough.* [65]

Further on in the same note Steward writes that,

> *….data and information are smaller than knowledge and, if it exists, wisdom. They are also different in kind. In computerese, eight bits equal one byte. But eight – or zubleteen zillion-bits of information do not equal a byte of knowledge. Knowledge is not a sum but a summation, a relation.* [66]

From the above definitions, knowledge has been defined as sets of beliefs that are dynamic during interaction between people, information, skills, facts, conditions, understanding, not a thing but something ephemeral that cannot be owned and something bigger than data and information that is also a summation or relation. At best, this compound definition can be described as accurate but confusing, yet corporations are spending significant amounts of money to manage knowledge even though it is ill understood!

One of the most important deductions that can be made from the above definitions is that knowledge itself does not have tangible physical attributes. Stacey's description of an *ephemeral process* seems to capture the jest of the definitions.

The definition that is used within this research (See 1.1.4 above) is the definition provided by Boisot. This definition combined with the definition of information, data and knowledge assets succeeds in decoupling the concepts, yet it encapsulates their relationships with each other. Boisot[67] defines knowledge as,

> *….the set of expectations that an observer holds with respect to an event*.

---

[65] Stewart. 2001, p6
[66] Stewart. 2001, p6
[67] Boisot. 1998, p20

Knowledge cannot be observed directly, but is *inferred from behaviour*. He adds that this disposition to act is *changed by the arrival of information* that is extracted from data. To illustrate this, Boisot et al[68] included the following diagram (Figure 4-1) to illustrate the dynamic nature of knowledge in relation to information and data.

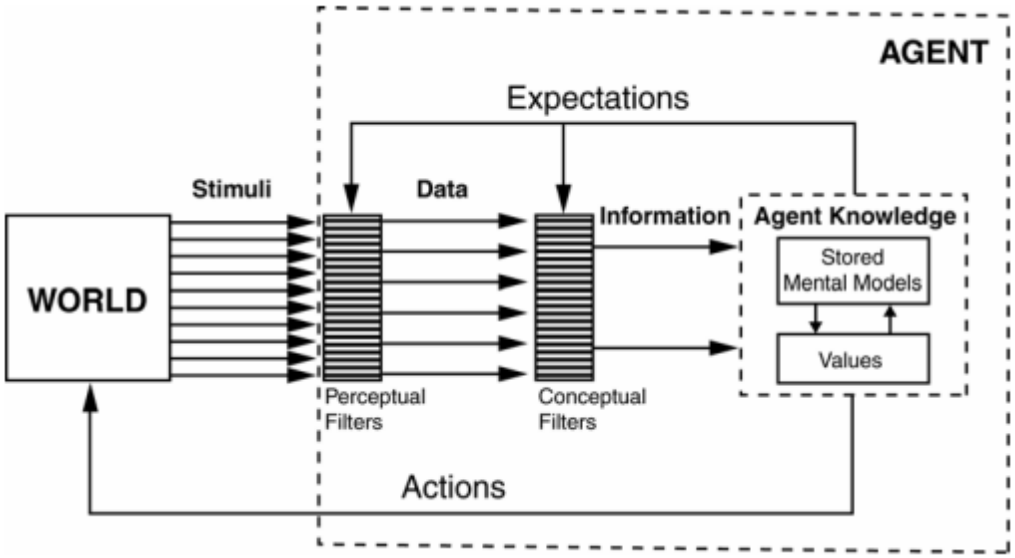


Figure 4-1: The Agent in the world

(Source: Boisot and Canals, 2008)

The World provides stimuli when there are discernible state changes in objects within the sensory domain of the Agent. Perceptual filters first orient the senses to certain types of stimuli that operate within a given physical range. Only stimuli passing through this initial filter get registered as data. Conceptual filters then extract information bearing data from what has been so registered. Both perceptual and conceptual filters are functions of the knowledge agent's knowledge. The information derived from the data influences or updates the knowledge agent's stored mental models and values, dynamically changing the perceptual and conceptual filters, but also causes the Agent to act on the world in a certain manner. It is this ability to act from which value is derived for the organisation. This ties in with the idea that knowledge is dynamic, but shows that the dynamism derives from an interaction between information, data and knowledge.

Therefore linking data, information and knowledge in this dynamic interaction shows the important role that knowledge plays in the enterprise and how it affects the value of the

[68] Boisot et al. 2008

information extracted from data. Knowledge thus plays an integral role in the data and information architecture of the organisation and cannot be ignored in the enterprise architecture.

Weick[69] describes a similar dynamic cognitive process in terms of sense making. Boisot et al's *filters* are similar to the *frames* described in Weick's argument and calls Boisot et al's *stimuli* similar to the *cues* in Weick. Weick states that a sense making agent typically draws on cues linked to frames in order to *create meaning*. Weick states that,

> *….frames and cues can be thought of as vocabularies in which words that are more abstract (frames) include and point to the less abstract words (cues) that become sensible in the context created by the more inclusive words.* [70]

Weick also states that sense and meaning require three things: two elements and a relation.

> *The combination of a past moment + connection + present moment of experience creates meaningful definition of the present situation.* [71]

Boisot el al.[72] goes further to explain that *knowledge assets are a subset of the agent's knowledge or more specifically, his disposition to act*, that is embedded in *individuals*, *groups* or even *artefacts* and that it has value-adding potential because it allows an agent to act in adaptive ways in and upon the physical world. It is just this ability to act adaptively that is the cause of knowledge assets being a very highly sought-after commodity in the information economy, since it is distinctive knowledge that allows for organisation to distinguish themselves from competitors even though their physical product might mostly be identical.

Steward[73] uses the concepts of *knowledge assets* and that of *intellectual capital* interchangeably, claiming they both mean *talent, skills, know-how, know-what* and *relationships* but adds that *machines* and *embodying networks* can also contain knowledge assets. He emphasises that knowledge assets can be used to create wealth.

---

[69] Weick. 1995
[70] Weick. 1995, p110
[71] Weick. 1995, p111
[72] Boisot et al. 2008, p100
[73] Stewart. 2001

Boisot[74] adds that knowledge assets can be the exclusive property of individuals or groups and are usually referred to as *intellectual property rights*.

Knowledge is therefore embedded within, and also links, the objects that are the subject of the enterprise architecture effort. Knowledge assets dispose the organisation to act in a certain way which might lead the organisation to gain a competitive advantage. From this it is possible to infer that knowledge is a source of value to the organisation and should be considered an asset.

4.2 Knowledge as an organisational asset

Before effort and resources are expended in implementing knowledge asset architecture, it is important to explore whether knowledge resources can be considered as assets to the organisation at all.

An asset, as defined by the Merriam Webster online Dictionary[75] is a*n item of value owned*

For knowledge to be an organisational asset, it needs to be owned by the organisation. This creates a conflict with Stacey's notion that knowledge cannot be owned. He defines knowledge as *an ephemeral, active process of relating*[76]. It is just this description of relating that makes it a candidate for analysis and consideration when the process of Enterprise Architecture is implemented. The IEEE, as described earlier, defines enterprise architecture as *the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution*[77].

Knowledge as a process of *relating* can thus be very closely associated with the fact that Enterprise Architecture is the organising of the organisation's components and *relations* to each other. The process of knowledge creation and the process of Enterprise Architecture seem to be inherently related to each other. The organisation can thus not own the knowledge, but it can own the elements affected by the knowledge through its relationships and embodiment.

---

[74] Boisot. 1998, p20

[75] asset. (2009). In Merriam-Webster Online Dictionary. Retrieved December 21, 2009, from http://www.merriam-webster.com/dictionary/asset

[76] Stacey. 2001, p4

[77] Harrison. 2007, p15

The next consideration to be discussed is whether knowledge, viewed as an asset, has economic value to the organisation.

The critical factors of production in the early 19th century were considered to be land and labour, both sources of energy, according to Boisot[78], who notes that capital later also became a factor of production; classical economists like Karl Marx considered capital to be merely *congealed labour.* In this argument Marx denied capital any legitimate claim to the fruits of production, even though capital was used to pay for the factors of production. Capitalists were appropriating the surplus of production illegitimately because, according to Marx, these surpluses belonged to the labourers as one of the factors of production in his model.

In rejecting the role of the capitalist, Marx also rejects the role of the entrepreneur, who brings a delicate blend of knowledge and risk-taking into the mix; in Marx's system there could be no reward for creating and providing knowledge or for taking any risks.

The demise of communism in its ideal form as proposed by Marx was clearly evident in the collapse of the Soviet Union, which illustrates in graphic terms the need for and value of knowledge in society.

Organisational value, competitive advantage and distinguishing factors are linked to knowledge assets because organisations need to possess the necessary knowledge to produce a basic product or service and apply additional knowledge to distinguish themselves from their competitors, a process otherwise known as a gaining competitive advantage.

Boisot et al. write that,

> *….economic agents, subject to the principles of least action and to the effects of the second law of thermodynamics, aim to economize on their consumption of both physical and data resources by deploying effective cognitive and behavioural strategies.* [79]

It is the economisation of physical and informational resources that will provide the **edge** over competitors as it will be possible to produce a product or service with higher stakeholder value and subsequently higher organisational value and appeal.

---

[78] Boisot. 1998, p25

[79] Boisot et al. 2008, p39

Now, following the fact that knowledge cannot be owned by the organisation, but that it seems to be a critical factor in the production process and an inherent part of the architecture of the organisation, one needs to understand certain the properties of knowledge assets.

4.3 Knowledge Asset creation

One of the aspects of knowledge assets that need to be explored is how they are created. The process of knowledge asset creation can be explained from different perspectives:

One perspective, namely the evolutionary production function of Boisot[80], describes how knowledge assets are created through an evolutionary process that eventually leads to a dominant design. This perspective does not concern itself with the cognitive aspects of knowledge creation, but rather with systemic cycles that lead to knowledge assets.

The other perspective, namely the process of sense making by Weick[81], describes the internal working of knowledge asset creation from a cognitive and mechanistic perspective.

The two approaches are merely aspects of the same process; they do not oppose but rather complement each other.

4.4 The evolutionary production function

The evolutionary production function as detailed by Boisot can be used to explain how knowledge assets are created.

Boisot[82] states that knowledge is created in two different stages within the evolutionary production function:

- Knowledge creation by *insight* occurs after information has been extracted from data and a breakthrough has been made that changes the paradigm of the area to which the knowledge has been applied. This insight does not happen gradually, but in irregular spurts and is often termed a breakthrough or major advancement. These insights can also vary in size and do not have to be a major event affecting humankind to be an insight. These insights however open up a new paradigm of thinking, for which very little data exists and for which surrounding methods are chaotic and ill-defined.

---

[80] Boisot. 1998, p25
[81] Weick. 1995
[82] Boisot. 1998,p25-31

- These insights are then developed over time by knowledge being *applied to experiential data*, resulting in improvements in efficiencies, data gathering and standardisation. This process moves the insight from a chaotic state into a complex state, where there is general acceptance of the knowledge and repeatable patterns that emerge in the production process. To move into an ordered state, the emergent patterns are bedded down through standardisation into methods, processes and techniques, which can be repeated in the production process.

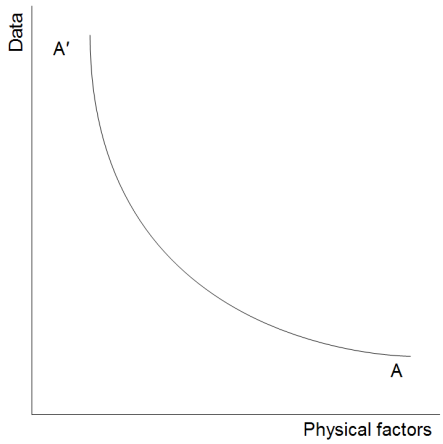


Figure 4-2 Evolutionary Production Function

(Source: Boisot, 1998)

The evolutionary production function (Figure 4-2) is taken in its entirety from Boisot[83]. It makes the assumption that *classical factors of production such as labour and capital are made up of entities that have both physical and informational attributes*.

The horizontal axis represents the relative space and energy consumption of the physical factors and the vertical axis represents the relative data related to the physical factors from which valuable information can be extracted.

Data has a physical basis because informational attributes are patterns extracted from data that, when applied in the form of knowledge, can modify the rate of consumption of physical

[83] Boisot. 1998, p25-31

space and energy because it has the ability to modify the behaviour of the physical attributes. These informational attributes can be embedded in animate and inanimate objects as data.

Information extracted from data becomes an abstraction from the production factors, giving it a representation as a production factor. Data, as items with a physical basis, is represented as a production factor, given the fact that information is only an abstraction from data. Data is thus the raw material of information and knowledge.

Information plays a role in the isoquant[84], indicating the *extractive operations* designed to economise on the processing of data. The isoquant, moving in time from A to A′ moves *towards the origin of the vertical axis*; there is a trade-off between the consumption of physical resources and the consumption of data, which moves it up the vertical axis towards the consumption of more data. The movement is *always asymmetrical* and will always move in the direction of increased consumption of data and decrease in the consumption of physical resources.

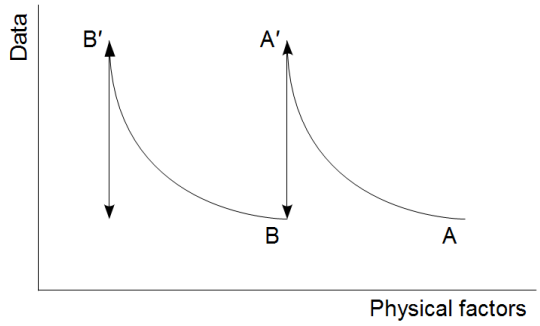


Figure 4-3 Shifting Isoquant in the Evolutionary Production Function

(Source: Boisot, 1998)

Figure 4-3 indicates the two types of movement on the evolutionary production function.

This process in increased data consumption occurs through a process of *differentiation*, *integration* and *the creation of memory stores*.

Knowledge assets emerge within two types of movement on the isoquant:

- *Creating Knowledge*: A *discontinuous* movement from top to bottom. This movement can be seen in Figure 4-3 as moving from A′ to B. Insight can be seen to be created through a

[84] An isoquant is a graph which depicts a set of point which have the same quantity of output for a changing quantity of two inputs respectively represented by the x and y axis

process of *extracting information from data*. Meaningful patterns are generated that convey useful information to the system that modifies its disposition to act. This movement reduces the complexity of a system through a process of metabolising data by *incorporation of useful data* and the *shedding of surplus data* through selective forgetting. This frees up capacity in the system for new learning. Insights *reduce the need for data processing* and *data storage* compared to the previous isoquant. It is an insight because it invariably *relieves pressure* on the system's memory and *reduces the load* on data transmission. This type of movement *cannot be predicted* from *prior knowledge* of the data that needs to be processed or the *characteristics* of the data processing agent. This movement is marked by system improvements and standardisation that tend to crystallise around features that are of most value. In the case of physical products, this phase is indicative of increased reliability, reduced parts and size and greater automation in manufacturing processes. Product attributes are likely to co-evolve and mutually constrain each other, leading to more standardisation and limiting the scope for product variation. These assist in the movement towards a *dominant design*.

- *Applying knowledge*: A continuous movement from bottom to top and left. This movement can be seen in Figure 4-3, moving from A to A′ or B to B′. It tests and improves on the insight by the *gradual accumulation of experiential data*. This learning process occurs in parallel with the knowledge creation movement. Learning is gained from experience and uses the previously described movement as a basis for development. In physical production, gains are marked by improvements in product weight, size, durability and manufacturing time, to name but a few. Complexity in this process is reduced by the generation of more data and moves the knowledge closer to the edge of chaos.

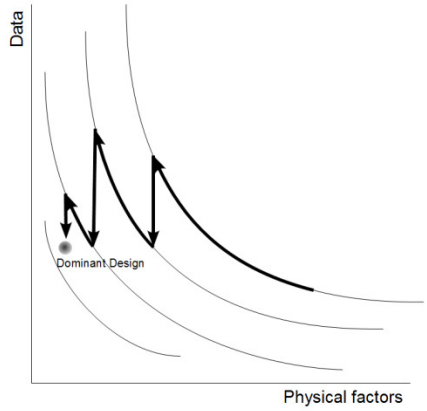


Figure 4-4 The trajectory of a Dominant Design in the Evolutionary Production Function

(Source Boisot, 1998)

Boisot makes the following observation:

> *Knowledge Assets are generated by a saw-tooth motion. Data accumulating over time inside a system in the form of experience or memory, first moves productive activity upward and to the left, following a given isoquant, and then drops it vertically downward from one isoquant to another as data gets reduced through the acts of insight that extract information from data.*

As knowledge assets cycle through the different types of learning they *tend to fossilise along a number of critical dimensions* due to the fact that the vertical movement introduces frameworks of structures and standards, while the second movement (up and to the left) occurs within these constraints, causing the knowledge asset to move towards a *Dominant Design.* Figure 4-4 shows how this trajectory can be depicted on the isoquant.

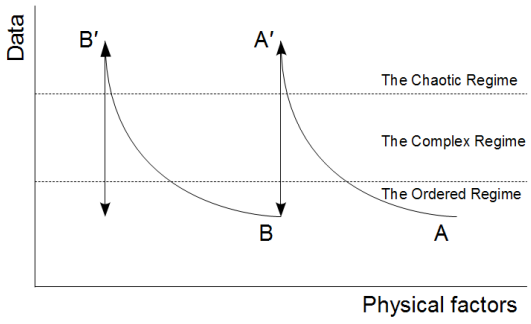


Figure 4-5 Cognitive Chaos, Complexity and order in the Evolutionary Production Function

(Source: Boisot, 1998)

As more data regarding the knowledge asset is gained through experiential learning, the cognitive complexity of processing that data increases. This will take a knowledge asset from an ordered state into a complex regime and perhaps to the edge of chaos as depicted in Figure 4-5. The creation of knowledge will bring the knowledge asset back into the ordered regime from where experiential learning will take over again.

Boisot states the following:

> *Effective learning requires us to blend complexity reduction – a downward movement in the evolutionary production function – with complexity absorption – an upward and leftward movement along a transformation curve.*

Knowledge Assets as an evolutionary production function over time, gains in data processing capacity while it economises on the usage of physical resources as it cycles through the different types of learning. This increase in data processing capacity can be found in various forms:

- Information and Communications Technologies enable many knowledge assets to improve by standardising associated processes, digitising data thereby improving processing capacity and ability to share.
- Relationships between individuals or organisations develop a common understanding, shared emotions and vocabulary over time. The complexity of the relationship increases over time to a point where chaos reigns. It is usually at this stage where some kind of intervention of insight is needed to bring the relationship back to the ordered regime. This can be in the form of a conflict that is resolved constructively, some time away where the parties in the relationship gain time to resolve issues in a calm environment or even the intervention of a specialist to help resolve the problems. This association can evolve over time (cycling through the evolutionary production model) to a point where the minimum data can be shared to extract information. A husband-and-wife relationship is a good example where, after years of marriage, a look or a facial expression can communicate to a partner an emotion or a feeling without having to say anything. This fact can be seen as a *dominant design*.

4.5 Sense making as knowledge asset creation

Karl E. Weick in his book *Sense making in Organisations* writes:

> *Sense making, however, is less about discovery than it is about invention. To engage in sense making is to construct, filter, frame, create facility and render the subjective into something more tangible.* [85]

Sense making as a process stands in contrast with the process of mere interpretation. Weick explains that interpretation literally refers to a process of *explaining one word with the use of another*. Interpretation merely discovers what already exists. Sense making reaches beyond the process of interpretation as it is "about authoring as well as interpretation, creation as well as discovery".

It is for these creative properties and the fact that sense making creates something new that was not previously there, that it is considered to be a process of knowledge creation.

Sense making as a creative process involves *placing stimuli into some kind of framework*, or what is otherwise referred to as a *frame of reference*. The stimuli from the environment outside the sense making agent are called *cues*.

Examples used to describe and study sense making are usually extreme cases *because it more clearly shows the properties of the process.* The fact is that sense making is something that happens naturally from an on-going stream of events – we are always in the process of making sense of something.

Sense making as it occurs within organisations is a complex operation that can be influenced by many factors. One such factor is the *fallacy of centrality* as Weick calls it. This is when barriers to reporting cause intelligence about an event to develop very slowly. The reason for this is that experts tend overestimate the likelihood of something not happening, because if it did, they, as the experts, should have known about it. This fallacy is damaging to the sense making process because it discourages curiosity on the part of the person that needs to make the sense and often such a person will take an antagonistic stance to such events because he/she simply does not believe that the events could be happening and that others must be misdiagnosing the situation.

Another factor that can possibly have an impact on sense making is described by Weick as the problem of highly organised and heavily networked organisations. Organisations relying on employees sticking to their *roles, expertise* and *stature* when they are performing routine

---

[85] Weick. 1995, p13

actions dependent on their dense and well-defined networks, are more likely to succumb to the trap of *fallacy of centrality*. Employees might discount *news* or other cues simply because they arrive later than expected or not through the official source. They are likely to argue that if it was important we would have heard about it sooner or through the official channel.

Employees' perception of information technology can also undermine its ability to facilitate sense making. The more advanced and integrated the technology, the more likely people are to trust only the technology while ignoring stimuli that are not proved by it. Highly developed information systems however are less likely to identify novel and out-of-the-ordinary events from which sense making should be originating.

Many organisations drive effectiveness through business process management initiatives: roles are segregated, processes are automated, standards are implemented and objectives are driven. These initiatives will theoretically greatly improve the performance of the organisation, but are likely to reduce the ability of the organisation to make sense of anomalies and take the appropriate action.

Weick summarises the process of sense making as follows:

> *Strategic plans are a lot like maps. They animate and orient people. Once people begin to act (enactment), they generate tangible outcomes (cues) in some context (social), and this helps them discover (retrospect) what is occurring (ongoing), what needs to be explained (plausibility), and what should be done next (identity enhancement).* [86]

The following diagram is a representation of the above description of sense making:

[86] Weick. 1995, p55

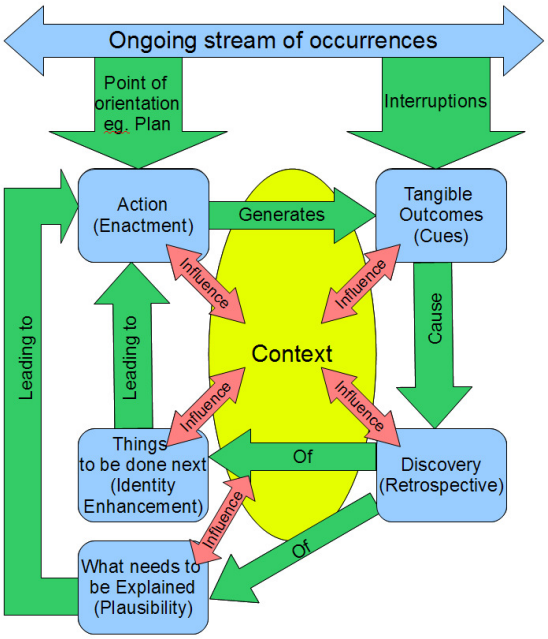


Figure 4-6: The process of sense making

(Source: Deduced by Author)

Weick has identified and described seven distinguishing properties of sense making, in order to better understand the process of making sense.

4.5.1 Identity construction

The first property is that sense making is grounded in *identity construction*. Here Weick asserts that sense making begins and ends with the individual making the sense, but points out that *no individual ever acts like a single sense maker.* Weick states the following:

> *Identities are constructed out of the process of interaction. To shift among interactions is to shift among identities. Thus the sense maker is himself or herself an ongoing puzzle undergoing continual redefinition, coincidental with presenting some self to others and trying to decide which self is appropriate.* [87]

Put in another way:

> *I make sense of whatever happens around me by asking, what implications these events have for who I will be in the aftermath of the events and the sense that I*

[87] Weick. 1995, p20

> *made. What the situation will have meant to me is dictated by the identity I adopt in dealing with it, and that choice is affected by what I think is occurring.* [88]

Castells elegantly defines identity as

> *the process by which a social actor recognises itself and constructs meaning primarily on the basis of a given cultural attribute, to the exclusion of a broader reference to other social structures.* [89]

The sense maker's identity shifts that determine the subject matter that is *perceived* but also depending on the subject matter that is *available*, can influence the identity of the sense maker. The process of developing shifting identities is driven by three needs of the sense maker:

- The need for self-enhancement or seeing oneself in a positive light
- The need for self-efficacy, which is the need to see oneself as competent and efficacious
- The need for self-consistency, which is a need to feel coherent and having an experience of continuity.

This holds a very important implication about how individuals make sense within organisations. Weick writes that,

> *….individuals' self concepts and personal identities are formed and modified in part by how they believe others view the organisation for which they work.* [90]

March[91] supports the role that identities play in decision making along the same lines:

> *Identities are both constructed by individuals and imposed upon them. Creating or accepting an identity is a motivational and cognitive process by which order is brought to the concept of self and to individual behaviour. It involves learning to act in a particular way. Identity development is a part of individual development, closely linked to the development of language and to and understanding of the physical and social environment.*

---

[88] Weick. 1995, p23
[89] Castells. 2003b, p22
[90] Weick. 1995, p21
[91] March. 1994, p62

March argues that identities are *embedded in a broader cultural context* and arise from a process of socialisation within which the identities are *adopted or imposed* rather than *discovered or created.* Very importantly he argues that identity *shifts from situation to situation as each situation highlights a different set of relationships.*

He also argues that individuals will use socially constructed identities that have been defined at a generic and abstract level as a *template* to define their own identities in the following ways:

- By defining the *essential nature* of the identities. The socially constructed identities basically provide *labels* that are associated with *properties* and *actions* that dictate the individual's behaviour
- By using the socially constructed identities as social *contracts*. In this case individuals accept these identities *in return for things that they value*. Socially constructed expectations are used by the group to reward and penalise individuals who have adopted the particular template.
- Socially constructed identities *define and assert morality*. Here the template defines what seems to be *good, moral and true,* after which the individual who has adopted the identity protects these values by *internalising* them. Feelings of pride, shame, guilt and embarrassment provoked by social reaction and the individual's conscious assets constitute the morality of the template.

It seems that Weick has left the idea of how identities shift within the sense making process as open-ended when compared to the more explicit approach from March. The reason for this may be that Weick assumes other factors than those presented by March to play a role, and that March's focus is on decision-making, which is arguably a subset of sense making.

This implies that the meaning and sense, which is a choice of several alternatives, that is made socially will likely be the one that reflects positively on the organisation. The result will be one that promotes the self-enhancement, self-efficacy and consistency. This means that the organisation is likely to take responsibility or disown the problem, be proactive or defensive, or be consistent or inconsistent when constructing their identity surrounding a sense making event. Weick writes:

> *The more selves I have access to, the more meanings I should be able to extract and impose in any situation.*

> *The more selves I have access to, the less the likelihood that I will ever find myself surprised.* [92]

For organisational sense making it is clear that sense making regarding events should be done collectively. Many sense makers will create a diverse set of identities, which in turn will result in multiple meanings that can be derived from the situation. This does not imply that a team of investigators is the best option when an event for sense making has occurred. Sense will be made by those whose self-enhancement; self-efficacy and consistency have been affected.

Identity construction is thus a *question about who I am, as indicated by the discovery of how and what I think.* [93]

The issues that we face around identity construction according to Castells[94] is how to *combine new technologies and collective memory, universal science and communitarian cultures, passion and reason* in a world that is *characterised simultaneously by globalisation and fragmentation.* He asks the question why *throughout the world an increasing distance can be observed between globalisation and identity, between the Net and self.*

4.5.2 Retrospective

The second property is the fact that sense making is retrospective. The reality that we perceive is always in the past. Weick writes:

> *People can only know what they are doing after they have done it.* [95]

This statement has interesting consequences for the idea that knowledge and information can be used to create foresight, as any intellectually conceived object is always in the past and therefore unreal in current time and the future. *Any intellectually conceived object is always in the past and therefore unreal. Reality is always the moment of vision before intellectualization takes place. There is no other reality.* [96]

We recall our experiences as a single event or a short chain of events. The reality however is that our lives are continuous chains of events and that we need to step out of the continuous

---

[92] Weick. 1995, p24
[93] Weick. 1995, p61
[94] Castells. 2003b, p22
[95] Weick. 1995, *p24*
[96] Weick. 1995, *p24*

flows and point to the single event or short chain of events after it happened. The fact that we only make sense of events after they have occurred has the following important implications:

- The creation of meaning from sense making is a process of attention to events that have already happened
- Whatever is occurring now (at the time when the meaning is being constructed about an event in the past) will have an effect on the result. Many possible meanings may need to be synthesised because the sense maker may have several ongoing concerns at the time of making sense, all affecting the possible meanings and outcomes that can be derived. The sense maker is faced with the problem of *equivocality* and *confusion* due to the many possible options that have to be synthesised.
- The meaning that is constructed is affected by whatever affects memory, because the event from which meaning is constructed has elapsed and can only be drawn from memory
- It is possible that the sequence and stimulus response can be a misleading analytical unit. We cannot choose the appropriate stimulus to analyse beforehand, because we will only give attention to the event after it has happened. By then the choice of the stimulus that will be used for analysis will be affected by the situational context and the constructed identity (as has been discussed already)

Dealing with the problem of equivocality and confusion, the sense maker needs to have values, priorities and clarity about the preferences to understand which concerns take priority.

The concept of retrospective sense making implies that a natural bias has been built into the process of sense making. We reconstruct the past from our memories, knowing the outcome of an event, which means that thing never happened exactly in the way that they are remembered. Keeping this in mind we need to understand that

- normal retrospective sense making in everyday life involves relatively short time spans between event and reflection. This means that memory is typically recent and fresh and the events are generally richly recalled;
- retrospective sense making only makes the past clearer, it will not make the past transparent, and
- once the sense maker has achieved the perception of self-enhancement; self-efficacy and consistency, he or she will stop with the process.

When people are asked to make predictions and do forecasts it is much more effective to ask them to imagine a point in the future and to make retrospective sense of events leading up to that point. This method of planning is called scenario planning.

Scenario planning according to Mintzberg et al.[97] is *a tool used in strategic planning where the future is uncertain and predictions cannot be made*. In these exercises participants create a *shared common view of the world* by speculating on different possible future scenarios by placing the present and the immediate future into a mock retrospective set of views, and then finding most likely future outcomes. This allows participants to share the common views that were created during the session across the organisation, rather than just presenting the organisation with a set of objectives as a strategic plan.

March[98] shows that experiences in retrospect can be recalled from three different sources:

- The most vivid of these are experiences that a person experienced himself or herself. A person seems to remember the positive and negative emotion that is associated with an experience more vividly than when someone else relates the retrospective events.
- A person is also likely to share experiences with others with whom they also share an identity, as March calls it. This means that it easier for people from the same team, culture or profession to share experiences.
- A person is also likely to record vivid concrete information more readily than pallid, abstract, statistical information. March makes the point here that stories convey retrospective happening much better than tables of graphs and balance sheets.

Retrospective sense making, in other words, is when a person *looks back at what they said earlier to learn what they think*[99].

4.5.3 Enactive of sensible environments

The third property of sense making is that is enactive of sensible environments. Here Weick refers to the fact that sense making essentially cannot be called sense making without being associated with creative action. In other words:

---

[97] Mintzberg, Ahlstrand and Lampel. 2005, p58
[98] March. 1994, p271
[99] Weick. 1995, p61

> *Interpretation better explains how people cope with entities that already exist, where sense making better explains how entities* ***get there in the first place***[100]

This property is really the crux of the argument that supports sense making as the way that knowledge assets are created.

Weick uses the word *enactment* to refer to the fact that people often produce part of the environment that they face. In this case the reference to an action does not necessarily mean an activity, but rather a creative action. Enactment according to Weick is similar to when legislators and managers construct a reality through their authoritative acts:

> *When people enact laws, they take undefined space, time and action and draw lines, establish categories, and coin labels that create new features of the environment that did not exist before.* [101]

People are part of the environments they help to create. Their actions or gestures (like choosing to ignore something) create the materials that become the constraints and opportunities that they face. The environment that we live in becomes a product of our actions, and we become a product of the environment that we helped to create.

We use sense making to socially construct or enact many things through the process of relating and cognition. Weick uses the following examples from Czarniawska-Joerges:

> *A stone exists independently of our cognition; but we enact it by cognitive bracketing, by concentrating our attention on it. Thus called to life, or to attention the stone must be socially constructed with the help of the concept of stone, its properties and uses.* [102]

Another example cited by Weick is the fact that buildings are socially constructed entities. We use brick, mortar, human labour, building regulations, architectural design, aesthetic expression and more to construct any building.

Enactment is about the fact that a person creates the object to be seen and inspected when they do and say things.

---

[100] Weick. 1995, p30
[101] Weick. 1995, p31
[102] Czarniawska-Joerges. 1992, p34

When March addresses the concept of action he links it to identity in the sense that individual action and what action is taken is linked to the identity of the person that takes the action. He says that an accountant will learn to do things the accountants' way. March writes:

> *Creating or accepting an identity is a motivational and cognitive process by which order is brought to the concept of self and to individual behaviour.* [103]

Weick does not weigh his properties of sense making against each other because they are very much entwined and play equal roles in the sense making process. The point of creation or enactment, as we have seen earlier is, according to Weick, the key difference between interpreting and making sense. Enactment is not only the result of sense making and knowledge creation but also a prerequisite. To re-quote Weick:

> *Strategic plans are a lot like maps. They animate and orient people.* ***Once people begin to act (enactment)****, they generate tangible outcomes (cues) in some context (social), and this helps them discover (retrospect) what is occurring (ongoing), what needs to be explained (plausibility), and what should be done next (identity enhancement).* [104]

Yet in many organisations the focus is very much on planning and analysis. Enterprise Architecture is often seen as a planning domain responsible for creating the *blueprints* for information systems. Creating and having spectacular plans do not seem to be the most important aspect of organisational success; in fact it seems that the plan can turn out to be much less comprehensive than what was expected.

Kalakota and Robinson write that,

> *…e-business initiatives hinge more on the creative ability of the artists than on the inherent solidity of the design.* [105]

They liken it to medieval cathedral building, where the master builder of the cathedral starts off with only a vague idea of the end product and improvises on the plan as he goes along, with very often completely different results than those originally expected.

---

[103] March. 1994, p62
[104] Weick. 1995, p55
[105] Kalakota and Robinson. 2001, p426

The very fact that we enact what we do changes our perception of the end product that we envisaged. Mintzberg et al.[106] describes the very nature of strategies as a something that has

- *an intended outcome*, or what has been planned originally, and
- *a deliberate strategy*, which realises a portion of those things that were originally intended,

The portion of intended strategy that was not realised is called the *unrealised strategy*, while an *emergent strategy refers* to that portion of the realised strategy that was not intended in the first place. Mintzberg et al. state that in this case organisations *take actions* one at a time *in effect testing the market. A realised strategy* is not necessarily what has been intended, but rather the result of the deliberate and emergent strategies.

The concept of intended, deliberate, emergent and realised strategies resonates with Weick's concept of sense making. The intended strategy causes deliberate actions to which people will orientate themselves and cause changes to the environment, and the emergent cues cause the organisation to

- stop a certain action, a form of enactment, causing an unrealised strategy,
- pursue another course, based on interpretation of the environment creating emergent strategies, and
- realise a pattern in the end.

From this we can derive the fact that people's ability to make sense of things is a contributing factor to why strategies and plans do not realise as intended. Our capacity to be innovative and creative causes us to change our plans on the fly.

There will always a significant element on improvisation in the realised strategy despite efforts to formalise the best defined intended strategy. Kanter[107] refers to strategy as *improvisational theatre* and also calls it *strategizing on the run.*

Kanter writes that innovation through improvisation is the heart of e-culture. She states that strategy emerges and is revealed through action, because when outcomes cannot be known in advance, the action itself creates the goal. This should encourage organisations to balance the

---

[106] Mintzberg et al. 2005, p11

[107] Kanter. 2001, p106

value attached to a *sense and respond* approach, better suited for complex environments, vs. the more traditional *plan, analyse and response* approaches used in traditional ordered environments.

Improvised strategy has the potential for causing upsets in traditional organisation when the intended strategy does not play out as planned. This research suggests that our ability to improvise on demand as part of the sense making process should be seen as a strength instead of a weakness.

On the evolutionary scale we have been successfully adapting to our environment on demand much longer than what we have making formal plans and bringing them to realisation. This is not to say that we should not plan, but we should also nurture the people who execute the plan's ability to be innovative and be creative in the execution process. Allowing for improvisation and emergent strategy is likely to lead to more robust and agile solutions.

It is inferred by this research that knowledge assets will play an important role in the organisation's strategy and enterprise architecture to understand the enacted environment, which is the result of an emergent or improvised strategy.

4.5.4 Social

The fourth property is that sense making is social. Weick states that,

> *….an organisation is a network of inter-subjectively shared meanings that are sustained through the development and use of a common language and everyday social interaction.* [108]

This description by Weick refers to the social dimension in many ways by using the words *network*, *inter-subjective*, *shared meanings*, *common language* and *social interaction*. It is important to highlight the fact that sense making as a form of human thinking is a social process.

Kanter[109] urges organisations to move from *cells to communities* which are a more social construct. She iterates that it is *not the computer that creates communities, it's the human connections; organisations should move from knowing together to working together, as e-culture centres around strong communities, online and off.*

---

[108] Weick. 1995, p39

[109] Kanter. 2001, p25

Weick states that:

> *….sense making is never solitary because what a person does internally is contingent on others. Even monologues and one-way communications presume an audience; the monologue changes and the audience changes.* [110]

One aspect of social sense making is the creation of a shared vocabulary or set of symbols that everyone in the organisation understands. Creating a shared meaning from which sense making can be done, says Weick, is however only one side of the coin:

> *Sense making is also social when people coordinate their actions on grounds other than shared meaning, as when joint actions are coordinated by equivalent meanings, distributed meanings, overlapping views of ambiguous events, or nondisclosive intimacy.* [111]

This means that organisations wanting to facilitate the social side to sense making should not stare blindly at the creation of shared values or shared meaning. In fact, Weick writes that,

> *….alignment may take place for any number of reasons, depending on the situation calling for joint action – the participants may fit their acts to one another in orderly joint actions on the basis of compromise, out of duress, because they may use one another in achieving their respective ends, because it is a sensible thing to do, or out of sheer necessity.* [112]

Using collaboration in an organisation to obtain shared values and shared meaning seems to be a hyped concept that does not carry much value. Weick assert that society should rather be seen as the formation of *workable relations*.

Kanter uses the construct of *collabronauts* when she states that,

> *….the best collabronauts are good at making connections, both human and intellectual. They are constantly on the lookout for new ways to benefit from combining forces with partners.* [113]

---

[110] Weick. 1995, p40
[111] Weick. 1995, p42
[112] Weick. 1995, p43
[113] Kanter. 2001, p137

Social sense making refers to the fact that what people single out and conclude on are determined by who socialised the person and how he was socialised, as well as by the audience the person anticipates will audit the conclusions that a person has reached.

The social dynamics of sense making and human thinking is not only an important aspect of this field of study; it is also the area where enormous change could be observed in recent history. The main drivers for these changes are technology-based, which arise from the fact that the world has grown much smaller due to cheaper and more pervasive ways to travel and the fact that information technology through the Internet can now connect communities with access to technology presently as common as a cellular phone to each other all over the world.

On discussing the relevance of the internet as an extension of true social behaviour versus a tool for people to assume fake identities and enact a fantasy world Castells writes the following:

> *The proliferation of studies on this matter distorted the public perception of the social practice of the Internet as the privileged terrain for personal fantasies. Most often, it is not. It is an extension of life as it is, in all its dimension, and with all its modalities.* [114]

Castells addresses these new dynamics when he says:

> *As an historical trend, dominant functions and processes in the Information Age are increasingly organised around networks. Networks constitute the new social morphology of our societies, and the diffusion of networking logic substantially modifies the operation and outcomes in processes of production, experience, power and culture. While the networking form of social organisation has existed in other times and spaces, the new information technology paradigm provides the material basis for its pervasive expansion throughout the entire social structure.* [115]

The power of what Castells calls the *network society* does not, according to him reside any longer in the social power of the individuals participating in the network, but rather becomes

---

[114] Castells. 2003a, p118
[115] Castells. 2003b, p500

subservient to the networking logic and the *social determination expressed through the networks.* Another way of expressing this would be that,

> *….the power of flows takes precedence over the flows of power.* [116]

In this case Castells defines a network as a *set of interconnected nodes*, where a node becomes the *point at which a curve intersects itself.* The concrete definition of a node is then directly dependent on what kind of network we are speaking of. Networks by nature, according to Castells, are open structures that *are able to expand without limits, integrating new nodes as long as they are able to communicate within the network, namely as long as they share the same communication codes (for example values or performance goals).* Castells refers specifically to social networks (a social structure with a network topology) as being *highly dynamic, an open system that is susceptible to innovating without threatening its balance.*

A network can be a network between people who are friends, or between employees or even practitioners in the same profession. A network can also be made up of interconnected nodes of groups of people like organisations and institutions that form links and partnerships. We can form links between financial institutions and between stock markets, the motor industry refers to dealer networks, where the strength in being interconnected lies in the fact that stock of vehicles and parts can be interchanged between the different nodes, providing wider variety and better optimal service.

Technology networks have become part and parcel of our lives and computer networks, telephone networks and cellular phones networks are now Ingrained in the fabric of society.

The power of making use of networks for organisation is explained by Castells in the following way:

> *The topology defined by networks determines that the distance (or intensity and frequency of interaction) between two points (or social positions) is shorter (or more frequent, or more intense) if both points are nodes in a network than if they do not belong to the same network.* [117]

---

[116] Castells. 2003b, p500

[117] Castells. 2003b, p501

Given the fact that one belongs to a network reduces the distance (physical, social, economical, political cultural) to a measurement that gravitates towards zero. This is in stark contrast to the measurement gravitating towards infinity between nodes that do not belong to the same network.

Castells emphasises the role that technology plays in enhancing networks as follows:

> *The inclusion/exclusion in networks, and the architecture of relationships between networks, enacted by light-speed-operating information technologies, configures dominant processes and functions in our societies.* [118]

Weick is not specific as to what social structure needs to be in place for sense making. The reason for this is that all sense making is by nature social and will feed off any social structure. Yet considering Castell's arguments about the power of social structures organised as and around networks, one can only conclude that the process of sense making will also be affected or enhanced by the presence of social structures organised around networks.

When one considers the argument made earlier in this research that sense making is a key element to knowledge creation and knowledge dynamics, then one can conclude that knowledge asset dynamics and value will also be enhanced by the presence and support of networks.

4.5.5 Ongoing

The fifth property of sense making is that sense making is ongoing, in the sense that it never has a starting or an ending point. Weick states that:

> *…people are always in the middle of things, which become things only when those same people focus on the past from some point beyond it.* [119]

When people make sense they extract cues from continual flows of events by focusing on a moment from within that set of flows. Weick states that it is widely recognised that people are always *in the middle of things*, but that there is a need to understand how that influences sense making.

The things that people are in the middle of, Weick calls *projects*, because they have a *particular purpose* and *private ends*. People see in the ongoing flows the aspects that bear on

---

[118] Castells. 2003b, p501

[119] Weick. 1995, p43

their projects. People immersed in flows are normally not indifferent to what passes them by, especially when there is an interruption in their *project*.

> *The reality of flows becomes most apparent when that flow is interrupted. An interruption to a flow typically includes an emotional response, which then paves the way for emotion to influence sense making.* [120]

Weick quotes six different properties that affect sense making regarding the fact that people are always in the midst of complex situations that they need to deal with: [121]

- It is impossible to avoid acting altogether; our actions, or choice of inaction affects the situation and yourself.
- It is not possible to step back and reflect on your actions; we are at the mercy of our intuitions and have to deal with the situation as it comes up.
- The effect of actions cannot be predicted, due to the dynamic and complex nature of social conduct.
- It is not possible to see a stable representation of the situation; it may be possible to extract patterns after the fact, but at the time the flow unfolds there is nothing but arbitrary fragments capable of being organised.
- All representations of the situation are only an interpretation of the situation there is no way to absolutely conclude that any representation is right or wrong, which implies that it is impossible to be completely objective.
- What is being said is action in itself; by saying something people will create, rather than describe a situation.

Weick importantly states that

> *the world is continuous and dynamic, yet we keep resorting to absolute categories that ignore large pieces of continuity, thereby entrapping us in misconceptions.* [122]

Weick asserts that there is an important link between *sense making*, *emotion* and the *interruption of ongoing flows*. Interruption of ongoing flows normally triggers an arousal that

---

[120] Weick. 1995, p45
[121] Weick. 1995, p44
[122] Weick. 1995, p44

prepares the person for a fight-or-flight reaction. This arousal will have psychological significance that triggers a rudimentary act of sense making, warning that there are some stimuli to which attention must be paid so that appropriate action can be taken.

Arousal of the autonomic system occurs with a delay of two to three seconds after the interruption, giving a person's instincts time to take direct action. Autonomic arousal acts as a backup in case the instinctive direct action does not work. Upon perception of arousal, people will attempt to construct some link between the present situation and the relevant prior situation to make sense of the arousal.

The emotional response will persist or increase until the interruption is removed or a substitute response is found that will allow the expected sequence to be completed.

Weick states that we should be using our understanding of autonomic arousal caused by interruptions in organisational flows to understand where and what kind of emotional sense making is likely to occur. In order to make use of this it is important to understand

- where in the organisation the interruption is more likely to occur, and
- how organised the action and plans are that are likely to be interrupted.

Weick states that

> *contrary to expectations, systems with newer, less well organised response sequence, settings, with fewer standard operating procedures and settings that are more loosely coupled, should be settings in which interruptions of ongoing projects generate less emotion because interruption are less disruptive.* [123]

Weick explains that the two possible types of emotion that can be discerned are: [124]

- Negative emotions, likely to be the result of an unexpected interruption that is perceived as harmful of organised behaviour sequence resulting in anger; emotions are likely to escalate in intensity if no means to remove or circumvent the interruption can be found.
- Positive emotions, evoked by the sudden and unexpected removal of an interrupting stimulus resulting in relief; another source of positive emotion is the sudden and unexpected completion of a plan or behavioural sequence resulting in pleasure.

---

[123] Weick. 1995, p46
[124] Weick. 1995, p47

According to Weick, opportunities for creating positive emotions within organisations are more difficult as the conditions that would trigger positive emotions are less likely to occur. Interrupting a stimulus is part of organisational life and less likely to produce positive emotions.

The likely result is that organisational sense making is more likely to occur as a result of negative emotions. The reason why these emotions affect sense making is that the recalling of retrospective events is more easily done when associated with a specific mood. Past events are recalled and reconstructed based on the way that people feel at the time they are trying to make sense. Thus similar experiences are not recalled on the basis that they look similar, but rather because they feel similar.

In other words: What a person says is spread across time and it competes for attention with other ongoing projects, and is reflected on after it is finished, which means that the person's interest may already have changed.

The nature of the flows is more closely examined from a social context by Castells when he breaks it down into space and time, which Castells sees as intertwined in nature and society. Ongoing flows in the form of space and time are *being transformed* by the effects of the *information technology paradigm* and the *social forms and processes induced by the current process of historical change*. He writes:

> *Our society is constructed around flows: flows of capital, flows of information, flows of technology, flows of organisational interaction, flows of images, sounds and symbols. Flows are not just one element of the social organisation: they are expressions of processes dominating our economic political and symbolic life.* [125]

Castells argues that the emergence of the *Network Society* is bringing a new dynamic to the intertwined nature of space and time in society. He proposes that space organises time in the *Network Society*, and adds that there is a *complexity* in the interaction between *technology, society* and *space*. On this topic he writes:

---

[125] Castells. 2003b, p442

> *Both space and time are being transformed under the combined effect of the* ***information technology paradigm****, and of social forms and processes induced by current processes of historical change.* [126]

From a social theory point of view, Castells writes that ...*space is the material support of time-sharing social practices* or put another way: S*pace brings together those practices that are simultaneous in time*. [127]

Castells identifies two kinds of spaces, which he calls the *space of flows* and the *space of places*[128]. A place in this context is defined as a l*ocale whose form, function and meaning are self-contained within the boundaries of physical contiguity.*

He argues that the global economy is *being organised around command and control centres that is able to coordinate, innovate and manage the intertwined activities of the networked firm*[129]. Advanced telecommunication systems allow for the advanced services that are required by the networked enterprise to be made available at *scattered locations around the globe* and do not necessitate close geographical proximity for these services to be of use. These services generally include, amongst others, financial services, information management and technology services, scientific innovation and security. Castells argues that all can be reduced to *knowledge generation and information flows.*

A *new industrial space* is at work where, according to Castells: *The technological and organisational ability to separate the production process in different locations while reintegrating its unity through telecommunications linkages, and micro-electronics-based precision and flexibility in the fabrication of components*[130]. This allows organisations to shift production processes to where labour forces are available with the skills required for the production processes.

The *new logic of space organisations* contains a key element that Castells refers to as the *milieu of innovation*. By this he means

---

[126] Castells. 2003b, p407
[127] Castells. 2003b, pxxxii
[128] Castells. 2003b, p453-459
[129] Castells. 2003b, p409
[130] Castells. 2003b, p417

> *A specific set of relationships of production and management, based on a social organisation and by and large shares a work culture and instrumental goals aimed at generating new knowledge, new processes and new products.* [131]

The milieu of innovation has the capacity to generate synergy:

> *The added value results not from the cumulative effect of the elements present in the milieu, but from their interactions.* [132]

This pattern referred to as the *milieu of innovation* within the industrial space is mainly organised around flows of information and it simultaneously brings together and separates the territorial components of the network enterprise.

Castells argues that this new pattern of society based upon knowledge and organised into networks gives rise to the informational city that is not a form within a geographical location, but rather a process characterised by the structural domination of the space of flows. The space of flows is the material organisation of time-sharing social practices that work through flows and consists of[133]:

- Material support in the form of *circuits of electronic exchanges*. Information technology support in the form of telecommunications networks, the Internet and high speed *always-ready* information technology infrastructure in the form of servers an mainframes are the objects that supports the material infrastructure for the *space of flows*. The information technology network becomes the *material support for simultaneous practices* which makes it a special form much like a town or city, but the space does not exist in a specific geographical location. Instead position in the space is defined *by the exchanges of flows in the network.* Castells states that *places* (in the traditional sense) *do not disappear, but their logic and meaning become absorbed in the network.*
- **Nodes and hubs** become the next layer in the space of flows. The information technology network links up nodes that exist in specific places, even though the network creates a spaceless logic. Each of these places has well defined *social, cultural, physical and functional characteristics.* Castells identifies two types of nodes in the space of flows, these are: *places of exchange*, or communication hubs that plays a coordination role of

---

[131] Castells. 2003b, p419
[132] Castells. 2003b, p419
[133] Castells. 2003b, p441-445

routing the messages and *places of strategic importance in the network*. The latter places are organised around *a series of locality based activities and organisation around a key function in the network,* examples of these are decision making systems like those relevant in the financial industry usually organised as a chain of services supporting an corroborating each other.

- **Managerial elites** become the third layer in the space of flows. These are people that *exercise the directional function around which such space is articulated.* The special logic of the *space of flows* according to Castells are *enacted or conceived, decided and implemented* by these individuals. He calls them the *technocratic-financial-managerial elite that occupies the leading position in our societies.* These people are specific about the special specifications and requirements about their interest and practices that they provide in the space of flows. These *elites*, according to Castells, are *cosmopolitan* as opposed to the *people* who are *location bound*.

The space of places is where people live and reside but are not the way in which function and power are organised. Function and power are organised in the space of flows which by the nature of it dominance essentially alters the logic of the space of places.

> *Experience, by being related to places, becomes abstracted from power, and meaning in increasing separated from knowledge. That follows a structural schizophrenia between two spatial logics that threaten to break down communication channels in society*[134].

Sense making in the space of flows is a much more strenuous and complex task than sense making in the traditional space of places due to the emerging schizophrenia. Cues generated in the space of places are generated within the context of the place where the sense maker finds himself and the sense maker can observe the context and the finer nuances of communication like body language, emotional expression and other subtle means of communication which are properties of face-to-face communications. In the space of flows, the cues that are generated are stripped from the context and the ongoing events that are generated – a sense maker in another node will have to imagine the context within which the cues were generated. The sense maker is also likely to interpret the cue within his or her

---

[134] Castells. 2003b, p458

context and location, which has the very likely result of misinterpretation and misalignment. It is for this reason that this research argues that the space of flows has a significant impact on the complexity associated with the making of sense and the utilisation of knowledge.

The separation of meaning from knowledge in the network society where there seems to be an increasing separation between the *elites* and the *people* will threaten our society's and organisation's ability to make sense unless, as Castells put it, *cultural, political, and physical bridges are deliberately built between these two forms of space.* [135]

Time is the other construct that is being affected by the information technology paradigm according to Castells. Castells argues that a new type of time that he terms *timeless time* is emerging in the space of flows as the dominant form, even though the space of places is still bound to normal time as we know it traditionally:

> *Timeless time occurs when the characteristics of a given context, namely the informational paradigm and the network society, induce systemic perturbation in the sequential order of phenomena performed in that context.* [136]

This perturbation, Castells argues, can take the form of: [137]

- *Compressing the occurrences* of phenomena that can be demonstrated by how technology is used by developed countries to shorten the time spans of wars. Technology is used to reduce impact on the general populace by aiming at the military might of the enemy alone, and to get the conflict over and done with as soon as possible, while back home television audiences follows the progress of the war in real time with the entertainment value of a reality show.
- *Aiming at instantaneity* can be demonstrated by how information technology and communication technologies have been used to instantly conduct capital transactions all over the world, in a financial space that is interconnected and where markets are continuously open. When markets in Tokyo close, the ones in London open, and when the ones in London get ready to close, the ones in New-York are ready to open, only to be replaced again by the Tokyo markets when it is time for New York to close – a phenomenon referred to by Castells as the *global casino*.

---

[135] Castells. 2003b, p459
[136] Castells. 2003b, p494
[137] Castells. 2003b, p494-499

- *Introducing random discontinuity in sequences* is explained by the way that the relationships between people and their work have changed, mainly due to the use of technology. Not only does it become possible to work flexible hours away from the office, effectively allowing people to take on a bigger workload, but medical science has also made people live longer, while other technologies in the work place reduce the time that people need to work, hence causing more people to retire early and having much longer retired lives than before. In addition to this the normal human lifecycle is also being blurred into what Castells terms *social arrhythmia.* Evidence of the way that this social arrhythmia manifests can be seen in the way that technology is used to change the way our species reproduce, and the way that our lives are extended by medical technology. Women now have the ability to choose to have children al later ages than what would have been possible naturally, and they can do this without necessarily knowing or having any contact with the father – the father may even be deceased. He also argues that we are separating death from the living by increasingly having people die in hospitals. *By separating death from life, and by creating the technological system to this belief to last long enough, we construct eternity in our life span.*

- *Eliminating sequences* can be explained by what Castells terms *virtual time*. Virtual time basically eliminates sequences from everyday phenomena. Information is now instantly available from within our own neighbourhood and from anywhere in the world, and the new types of media makes it possible to mix the different times in what Casells terms as the *temporal collage where not only genres are mixed, but their timing becomes synchronous in a flat horizon, with no beginning, no end and no sequence.*

  Therefore knowledge asset architecture will be concerned with the on-going networks of flows that exist in the organisation. It will not only be important to understand which the prominent flows are, but also to anticipate the result of interrupting or altering any of the relevant flows.

4.5.6 Focused on and by extracted cues

The **sixth property** of sense making is that sense making is *focused on and by extracted cues*. On this Weick writes that:

> *Extracted cues are simple, familiar structures that are seeds from which people develop a larger sense of what may be occurring*[138]

According to Weick the art of leadership lies in part by the ability to *generate a point of reference*, against which a *feeling of organisation direction* can emerge. The ability to control the point of reference to which people are orientating themselves *hold the potential for significant power*.

Weick goes further to say that a cue that is extracted to develop into the sense that is made. He uses the metaphor of a seed that is not a plant, but it points to a plant and can become a plant. The sense that is made from a cue depends on the context within which the sense is made.

The context within which the sense is made influences the process in two different ways: [139]

- *Context affects what is extracted as a cue in the first place*. This process has been described as the process of scanning, noticing and searching. The things that we scan for include things that are *novel or perceptually figural in context, people or behaviours that are unusual or unexpected, behaviours that are extreme and negative and stimuli relevant to our current goals*.
- *The context affects how the extracted cue is then interpreted.* The term indexicality is used to refer to the fact that the relevant meaning is extracted within the context of an object. Without that context, multiple meanings can be extracted. *The social context is crucial for sense making because it binds people to actions that they then must justify, it affects the saliency of information, and it provides norms and expectations that constrain expectations*.

Weick argues that context within in an organisation incorporates politics:

> *People in organisations are in different locations and are familiar with different domains, which mean they have different interpretations of common events. When these conflicting interpretations are aired they create political struggles.* [140]

---

[138] Weick. 1995, p50
[139] Weick. 1995, p51
[140] Weick. 1995, p53

Political dynamics in organisations, or *wheeling and dealing* as Morgan[141] describes it, was seen by Aristotle as *a means of creating order out of diversity while avoiding forms of totalitarian rule.* Politics is mainly associated with the balance of power and rule in an organisation and Morgan describes several types of rule with different political dynamics. These types of political systems range from the a*utocratic,* where all the power is held by a specific individual to a *direct democracy* where everyone in the organisation has an equal right to rule.

According to Morgan[142], organisational politics can be analysed as the relations between *interest, conflict and power.*

- Here **interest** is described as *predispositions embracing goals, values, desires, expectations and other orientations and inclinations that lead a person to act in one way rather than another.* This definition ties in closely with the earlier definition of a knowledge asset which is the *set of expectations that an observer holds with respect to an event. It is a disposition to act in a particular way.* Morgan identifies three types of interest that people hold with regards to political interests namely *task interest*, pertaining to the task at hand, *career interest* which pertains to the person's position and aspirations within the organisation and *personal interest*, referring to a person's personal life. Weick calls these ongoing items in a person's life *projects*, or things that a person is busy with having an expected outcome and interruptions of these projects are occasions for sense making, giving rise to political power struggles. An important observation made by Morgan is that these domains of interest are interconnected and influences each other, creating a kind of political struggle within a person.
- **Conflict**, according to Morgan, arises *when interests collide*. Conflict is often seen as a *dysfunctional force* which arises due to *regrettable circumstances*. On the contrary, according to Morgan, conflict is always part of organisations and occurs on *personal, interpersonal* or *intergroup level*. Conflict occurs amid the fact that everyone in the organisation is collaborating to make the organisation a success. General sources of conflict, amongst others, are often related to individuals' aspirations to reach positions higher up in the organisational structure, or workers finding ways to circumvent their

[141] Morgan. 1997, p154
[142] Morgan. 1997, p153-213

superior's expectations. Morgan warns that underlying conflicts that have become institutionalised in *attitudes*, *stereotypes*, *values*, *beliefs* and *rituals* among others, can become difficult to identify and break down, not withstanding the fact that it can become counterproductive.

- **Power**, according to Morgan is *the medium through which conflicts of interest are ultimately resolved. Power influences who gets what, when and how*. Morgan refers to Robert Dahl's definition of power that suggests that *power involves an ability to get another person to do something that he or she would not otherwise have done.* There seems to be a strong link between power and knowledge assets that suggest that control of knowledge assets is one of the primary sources of power in organisations. According to Morgan, knowledge and information is a key component in how power accrues to a person and control over these resources *a person can systematically influence the definition of organisational situations and create patterns of dependency.* Skilful managers can control information flow and the knowledge that is made available to different people, *thereby influencing their perception of situations and hence the way they act in relation to those situations*. A democratic leader will likely manage *meaning and interpretation* in the organisation by *listening, summarising, integrating and guiding what is being said, making key interventions and summoning images ideas and values that help those involved to make sense of the situation with which they are dealing.*

Weick suggest that an important point to make about cues is the fact that *cues tie elements together cognitively. The presumed ties are then given more substance when people act as if they are real:*

> *A presumed order becomes a tangible order when faith is followed by enactment.* [143]

Weick states that,

> *….extracted cues are crucial for their capacity to evoke action and processes for sense making tend to be forgiving. Almost any point of reference will do, because it*

[143] Weick. 1995, p54

> *stimulates a cognitive structure that then leads people to act with more intensity, which then creates material order in place of presumed order.* [144]

In other words the fact that sense making is extracted by cues means that *what is singled out and embellished as the content of the thought is only a small portion of the utterance that becomes salient because of the context and personal dispositions*.

Therefore knowledge asset architecture will be concerned with the context from which cues for sense making, i.e. knowledge creation and utilisation, are extracted. The organisational political landscape will be of special interest to the enterprise architect, especially where it relates to the points of reference where cues will be extracted and made sense of.

4.5.7 Plausible

The **seventh** property of sense making is that sense making is *plausible*. Here Weick[145] argues that plausibility trumps accuracy as a basis for sense making:

> *The strength of sense making as a perspective derives from the fact that it does not rely on accuracy and its model is not object perception. Instead, sense making is about plausibility, pragmatics, coherence, reasonableness, creation, invention and instrumentality.* [146]

This is primarily based on the way that people reason when they are making sense. Weick states that plausible reasoning digresses from deductive reasoning because:

- Plausible reasoning is not necessarily correct, but it fits the facts even if it does not do so perfectly
- The reasoning is based on imperfect information

Boisot et al.[147] refer to imperfect information as fuzzy sets where the *boundaries of the information are not sharply defined*. *Fuzzy sets* stand against *crisp sets*, where there are clearly defined boundaries for the information. When working with fuzzy sets, the agent needs to shed what he perceives as random data or noise and retain the data which he perceives as useful. This is of course not primarily based on the accuracy of the data, but

---

[144] Weick. 1995, p54
[145] Weick. 1995
[146] Weick. 1995, p57
[147] Boisot et al. 2008, p88

rather on what value the data holds in respect to the problem that is being addressed. The agent is thus likely to retain the data which makes sense within his context before he concerns himself with the accuracy of the data.

Weick notes the following reasons why he believes that accuracy is a secondary consideration in any analysis: [148]

- In order *not to be overwhelmed by the data* people will use their current projects to *distort* and *filter* the noise they receive into separate signals. For this people will invoke several *filters* for *different reasons*, with different criteria, *including* and *excluding* different things.
- Sense making embellish and elaborate on a single point of reference that is a cue that has been extracted. *Embellishment occurs when a cue is linked with a more general idea*. The most likely linkage of an object will be to a similar object/cue on which sense was made in the past. Remembering the past requires a reconstruction which cannot be recalled accurately in any way. Weick argues that having accurate and complete meaning is probably a *doomed intention* because extracted cues can have multiple meanings and interpretations. Thus accuracy is meaningless when used to describe a filtered sense of the present, linked with a reconstruction of the past that has been edited in hindsight.
- The necessity for speed and a quick response may shape events before a single meaning can be extracted. Here Weick argues that keeping a *constant close look* on a complex environment is often too costly in terms of the time it takes to and the capacity needed to process all the required data. The interruption and interval before autonomic arousal (as described in the on-going property 4.5.5 above) causes the sense maker to be more concerned with continuation of his/her project than with accuracy.
- Accuracy will only become a concern for a short period of time for a specific question. Weick explains two types of accuracy that sense maker are likely to be concerned with, describing them as g*lobal accuracy* and *circumscribed accuracy*. According to Weick the sense maker is more likely to be concerned with circumscribed accuracy specific to an event.

---

[148] Weick. 1995, p57-61

  - Global accuracy in this case is described as accuracy that allows the perceiver to *form widely generalised beliefs*.
  - Circumscribed accuracy is focused on specific events within a *limited number of contexts* and for a *brief period*.

- Accuracy is more relevant when sense makers study *object perception* rather than *interpersonal perception*. Objects as the targets of sense making possess identities that are *immutable and constant*. Making sense of organisational life are, however, more likely to be concerned with the identities of *interpersonal perceptions*. The identities of people, as described earlier, constantly shift and are multiple as part of the process of sense making. Obtaining accuracy within this shifting environment is very difficult in the face of environmental constraints.
- Accuracy is defined by instrumentality. This means that what is believed to be accurate is defined by whatever is believed to counteract interruptions and facilitate ongoing projects. Weick argues that **accuracy is pragmatic**. He describes the reason for this point of view as the fact that *enactment in the pursuit of projects provides the frame within which cues are extracted and interpreted and in turn circumscribes the area within which accuracy matters.*
- Weick argues that accuracy is a reflex of the environment within which it is defined and is as a result inconsequential. A bold actor is adaptive of the environment within which he acts. As Weick puts it: *People construct that which constructs them, except both constructions turn out to be the same thing.* He goes further to state that *people who want to get into action tend to simplify rather than elaborate.* This means that people tend to filter responses, creating biases in the process of extracting simple actionable cues. These filters create perceptions and perceptions, by definition, can never be accurate because by the time people notice and name something, it has become something else and no longer exist.
- Weick also argues that at the time of perception is will almost be impossible to tell whether the perception will prove to be accurate or not. He substantiates this by saying that *perceptions are partly predictions that may change reality, because different predictions may lead to similar actions, and because similar perceptions may lead to different actions. Many perceptual errors become erroneous only in retrospect.*

Weick then answers the question about what is necessary if we say that accuracy is not the prime consideration during sense making. On this he writes the following:

> *The answer is: something that preserves plausibility and coherence, something that is reasonable and memorable, something that embodies past experience and expectations, something that resonates with other people, something that can be constructed retrospectively but also be used prospectively, something that captures both feeling and thought, something that allows for embellishment to fit current oddities, something that is fun to construct. In short, what is necessary in sense making is a good story.* [149]

Weick makes the point that sense making is about *plausibility*, *coherence* and *reasonableness*. Sense making is about accounts that are socially acceptable and credible.

Plausibility in other words say that *a person needs to know enough about what they think to get on with a project, but no more, which means sufficiency and plausibility take precedence over accuracy*.

Therefore decision support systems which have an overly emphasised focus on information accuracy is likely to deliver less value than a similar system which balances accuracy with information values such as *proactiveness, transparency, integrity, sharing, control and formality*. [150]

March echoes Weick's view on the role that accuracy and completeness plays in the decision making process. He states the following:

> *Decision makers gather information and do not use it; ask for more and ignore it; make decisions first and look for relevant information afterward; gather and process a great deal of information that has little or no direct relevance to decisions.* [151]

According to March, certain challenges present themselves with the use of accurate information to make decisions:

---

[149] Weick. 1995, p60

[150] Marchand, Rollins and Kettinger. 2001, p280

[151] March. 1994, p226

- When information is compared across time in order to understand trends so that future outcomes can be predicted, he writes the following: *Comparisons across time are particularly difficult because preferences and identities are not stable; they are changing in part as a result of decision making.* [152] The problem is that comparison of data over time then presents a set of difficulties in terms of context. The decision maker is situated within a current context with data from a previous context which he cannot remember or did not know to start with attempting to predict something in a future context which he cannot possibly comprehend due to the complexity of the matter. The decision maker thus has to assume a stable context, which as we have seen is not likely to happen.

- Information comparison across multiple decision makers presents a different set of challenges due to the inherent *inconsistencies* of individual decision makers. March writes that *incomplete attention to inconsistencies in preference and identities is added by mechanisms that conceal the contradictions. Organisations divided into departments and labour are divided among specialists, thereby reducing the likelihood that inconsistencies cutting across decisional or speciality lines will impinge on decision making.* [153]

  From this is it clear that in an environment riddled with inconsistencies and complexity (and few environments can be categorised as perfect) the sense maker is more likely to think up and elaborate a story that fits the inconsistencies and complexity, using the information available, accurate or not, to build up the elaborated story supporting the sense that is being made. This process is neither rational nor accurate, but reflects the natural process of sense making that human beings apply.

  This line of thought is not new, neither is it counter-productive; instead it is the wonderful way that we human have always been dealing with complexity. Segregation of work and scientific method like those introduced by Adam Taylor and Henry Ford, has left a culture of performance- driven organisations where input and outputs are measured relentlessly.

  The Information Age enabled organisational integration on a much grander scale than before, but also created a much more complex environment within which decisions are

---

[152] March. 1994, p228
[153] March. 1994, p230

made. This calls for the relearning of age-old methods, like the telling of stories to assist in moving forward in the new paradigm.

4.6 Knowledge creation within organisations

Sense making according to Weick[154] occurs on three different levels:

- **Inter-subjective sense making**, which occurs when individual thoughts, feelings and intentions are merged or synthesised into conversations during which self get transformed from *"I"* into *"we"*. On this level sense is being made of events and occurrences that occur on day to day life on a level of social reality between two or more communicating selves.
- **Generic subjective sense making**, which occurs in cases **where *concrete human beings, subjects are no longer present***. Instead the "*we"* is done away with and reference is made to roles and other abstract terms. This type of sense making, according to Weick, is the dominant form of sense making in organisations[it refers to meaning related to *generic selves that occupy roles.*
- **Extra-subjective sense making**, which refers to sense making where the *generic self* is now replaced with *pure meaning*. This level is very abstracted and Weick calls it symbolic reality as associated with subjects like mathematics, geography and other fields of study or subject areas. The organisational culture is described at this level and can be conceptualised as *an abstract idealised framework derived from prior interaction.*

Weick argues that organising lies atop the movement between the inter-subjective and the generic subjective sense making. This type of organising is described as a mixture of two types of sense making:

- Vivid unique inter-subjective understanding, and
- Understandings that can be picked up, perpetuated, and enlarged by people who did not participate in the original discussions.

This type of sense making greatly assists in understanding the type of activity that has been described in Boisot's evolutionary production function.

---

[154] Weick. 1995, p71-74

The movement in the isoquant, depicted in Figure 4-3 as being from A to A′, is the product of generic subjective sense making. This is the process described by Boisot as the process used to *apply knowledge* that moves from a chaotic to an ordered state. Weick has this to say about the process of translating the inter-subjective sense into generic subjective sense:

> *It involves shifts from relative autonomy to relative control and from relative independence to relative interdependence.* [155]

The movement in the isoquant as depicted in Figure 4-3 from A′ to B is the product of *inter-subjective sense making*. Boisot refers to this process as the process that *creates knowledge*. This process is described as a *discontinuous movement* of *insight.* Weick argues that this inter-subjective sense making *forms, creates, preserves and implements the innovation that arises from intimate contact*.

From this is it possible to argue that the evolutionary production function described by Boisot for creating and applying knowledge and the concepts of inter-subjective sense making and generic subjective sense making described by Weick support each other to explain different perspectives on the dynamics of knowledge assets within the organisation.

According to Weick[156] inter-subjective sense making has the potential of being lost as organisations drive for higher levels of control. According to Boisot[157] organisations for practical reasons show a strong preference for *complexity reduction* (generic subjectivity) over *complexity absorption*. The reason for this is that inter-subjective sense making will lead to a steady accumulation of tacit, experiential knowledge inside the organisation. The perceived problem with this kind of knowledge is that it remains locked up in the heads of the possessors of the knowledge and can only be communicated with difficulty. When the individual leaves, his tacit knowledge goes with him, and as such productive organisations find it a better strategy to invest in the articulation of knowledge and complexity reduction.

Weick warns against this approach when he writes:

---

[155] Weick. 1995, p72
[156] Weick. 1995, p73
[157] Boisot. 1998, p38

> *Control drives out innovation, organisation becomes synonymous with control, and generic subjectivity becomes sealed off from any chance for reframing, learning or comprehension of that which seems incomprehensible.* [158]

4.7 The epistemological orientation of the knowledge asset

Epistemology is described by the Merriam Webster On-line dictionary as follows:

> *The study or a theory of the nature and grounds of knowledge, especially with reference to its limits and validity.* [159]

Plato defined knowledge as *justified true belief* in the Meno and the Theaetetus (400 BC). According to these, knowledge is built up of three components:[160]

- An element of truth or fact that cannot be refuted and adheres to natural laws,
- an element of justification that underpins the knowledge, and
- the fact that there is belief in the knowledge.

Boisot, MacMillan and Han state that all knowledge is the beliefs that knowledge agents hold and that they are willing to act on. They describe the world of an agent's knowledge as that space in which the knowledge represents everything that is possible (the agent holds the belief without it being justified or truthful), everything that is plausible (the agent believes it to be true), everything that is probable (the knowledge has been justified) and the actual domain where the knowledge is true and justified (as in Plato's definition). These terms are depicted in Figure 4-7.

---

[158] Weick. 1995, p73

[159] *epistemology* ."Merriam-Webster Online Dictionary. 2010. Merriam-Webster Online. 2 May 2010 Availabe at: http://www.merriam-webster.com/dictionary/epistemology

[160] Boisot and MacMillan. 2008, p52

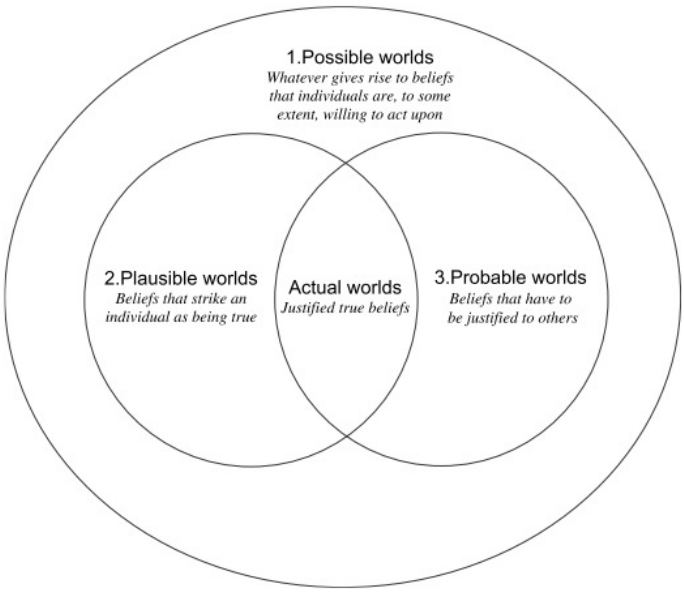


Figure 4-7 Possible, Plausible, Probable and Actual Worlds

(Source: Boisot, MacMillan and Han, Explorations in Information Space)

All knowledge assets, whether they are physical architectural artefacts or expressed opinions and views, will fall within one of the domains of *possible, plausible, probable* or *actual knowledge.*

It is the function of enterprise architecture to understand and influence the knowledge assets based on the domain in which they are perceived to be. Boisot, MacMillan and Han states that a *key skill in knowledge management involves understanding the basis on which an agent can move the product of its thoughts across the epistemological boundaries*[161] *(*as represented in Figure 4-7). It may be that an artefact has been justified and is part of the probable domain, and now needs to be marketed to the organisation as a truth to bring it into the actual domain for maximum effect and value.

Some knowledge assets may only be available as truths and will be challenging to justify; the architecture community will have to decide whether an approach of *repeated corroboration through testing* can increase the probability of the knowledge asset.

Other knowledge assets may lack plausibility and can possibly be carefully analysed and reflected upon in order to gain the plausibility required.

---

[161] Boisot et al. 2008, p48

The choice of hypotheses in the possible world outnumbers the probable and plausible world significantly. Here an agent will need to use good reason for selecting one hypothesis rather than another for further development and testing.

Enterprise architecture is one of the few roles in the organisation that takes a holistic view of the organisation, seen from different points of view and can act as a change agent to move knowledge assets from one epistemological domain to another for the benefit of the organisation.

> *What constitutes a significant regularity, however, can only be established with respect to the individual dispositions of the receiving agent. Information, in effect, sets up a relation between in-coming data and a given agent. Only when what constitutes a significant regularity is established by convention, can information appear to be objective – and even then, only within the community regulated by the convention.*[162]

Effective cognitive strategies extract information from data and then convert it into knowledge. Effective cognitive and behavioural strategies vary from agent to agent as a function of their situation, of their prior individual knowledge, of their values, and of their emotional dispositions.

The epistemic boundaries of a knowledge agent are functions of the knowledge agent's mindset. Boisot, MacMillan and Han argue that *an entrepreneurial mindset will likely favour an initial move from possible to the plausible worlds.*[163] A m*anagerial mindset* on the other hand *is focused on the need to justify its epistemic stance* and is *generally more disposed to move into actual worlds via probable ones, and building its theories on the basis of available empirical evidence rather than seeking out evidence in support of a priori theories that have been subjectively derived.* [164]

Where the boundaries are within a group it is a function of the group's culture or social practices. Boisot et al. state that *society has a large say in establishing what gets placed within each of the worlds and what gets excluded.* They also state that organisations will base their boundaries on society, but would also want to have input about where the boundaries lie

---

[162] Boisot et al. 2008, p19
[163] Boisot et al. 2008, p63
[164] Boisot et al. 2008, p64

in their organisations. Draw the boundaries too tightly and you stifle innovative moves; draw them too loosely and scarce resources are squandered.

Boisot, MacMillan and Han explain how movement over the epistemological boundaries affects knowledge within organisations. Moving from the outside of the circle towards the centre where Domains 2 and 3 intersect, acts on already existing knowledge to reduce uncertainty and render knowledge more reliable and usable. A movement in the opposite direction, from where domains 2 and 3 intersect towards the edge of Domain 1, creates new knowledge: (It) *broadens the horizons of awareness and can sometimes lead to radical restructuring of what has already accumulated in the inner regions.* [165]

Boisot et al. suggest that effective Knowledge Management strategies will maintain a balance between the outward and inward movement through the models and being cognisant in which domain – plausible, probable or possible – the knowledge asset was operating in at any given moment. For this two different mindsets are needed:

- A managerial mindset that will facilitate movement from the outer regions to the intersecting region of domains 1 and 2, and
- An entrepreneurial mindset that will facilitate movement to the edge of the diagram and into the possible world.

One of the problems faced by business today is the fact that the entrepreneurial mindset has mostly been drowned out by the managerial mindset. Boisot et al. state that *current institutional practice is heavily skewed in favour of the managerial mindset.* [166] The challenge that organisations face is to find a balance between these two types of mindsets that is at once efficient and innovative, and not letting one approach stifle the other. Boisot, MacMillan and Han believe that the balance can only be redressed effectively when organisations *become more epistemologically aware*.

4.8 The dynamics of Knowledge Assets

Boisot writes that the acts of codification and abstraction are the key elements to economising on data:

---

[165] Boisot et al. 2008, p66

[166] Boisot et al. 2008, p67

> *Further, we take the securing of such data economies as a crucial prerequisite of effective communication and, by implication, of organisational processes.* [167]

Knowledge assets are by definition dynamic entities which could exist in different states and could have different value and meaning to different people or to the same person at different times. Most of these dynamics have been described using Weick's Sense making (see 4.4) and Boisot's Evolutionary Production Function (see 4.5) concepts.

Knowledge Assets are largely conceptual entities which are difficult to represent in concrete form. Working with abstract concepts like Knowledge Assets is not a new idea in the Enterprise Architecture space, but it is important to have some way to represent knowledge assets conceptually in order to explore their dynamics and communicate their meaning to others.

Three main dimensions have been identified by Boisot and other authors[168] [169], and can be used to measure and describing the common properties of Knowledge Assets. These dimensions described in the following sections are:

- The degree of codification
- The degree of abstraction or concreteness
- The degree of diffusion.

4.8.1 Codification

Boisot defines the process of codification as,

> *….the creation of perceptual and conceptual categories that facilitate the classification of phenomena. The act of assigning phenomena to categories, once these have been created, is called coding.* [170]

At one end of the scale are knowledge assets that have low codification, which refers to knowledge as being *hard to articulate* or simply as *not having been articulated* and is deeply imbedded in the organisation's information objects. At the other end are *highly codified knowledge* assets that are readily available and well understood. Knowledge that is highly

---

[167] Boisot. 1998, p41
[168] Boisot. 1998
[169] Boisot et al. 2008
[170] Boisot. 1998, p42

codified can for example be codified into a database with a proper object-oriented or relational structure where data is stored. Well codified knowledge is not necessarily knowledge that has been written down or explicitly expressed. Codified knowledge can be any kind of knowledge where well-defined categories for expression exist.

Even though codification has a strong relationship with Nonaka et al's view of tacit and explicit knowledge, it should not be confused with tacit and explicit knowledge. Nonaka et al. state that,

> *….there are two types of knowledge: explicit knowledge and tacit knowledge. The former is objective and rational knowledge and can be expressed in such forms as data, scientific formulas, specific actions and manuals; the latter is subjective and experiential and hard to formalise. Beliefs, perspectives, mental models, ideas and ideals are examples of tacit knowledge.* [171]

It is also important to note that knowledge assets are not categorised as being either tacit (un-codified) or explicit (codified) but that codification of knowledge assets can vary in degrees of codification, with one being completely un-codified at one extreme, to being well codified at the other. Nonaka et al, support this notion when they state that,

> *….we do not view knowledge as something absolute and static, as in the case with traditional Western epistemology (the theory of knowledge). We view knowledge as context-specific, dynamic and humanistic.*

For knowledge to be expressed in an explicit form requires the ability to associate and discriminate the resulting data, which becomes increasingly difficult if there are no categories or codes to express the knowledge asset in an explicit format; it is also entirely possible that knowledge can be only tacitly known, while the codes and categories to express them are still well known and established.

Less codified objects are of a complex nature and the *degree of codification is inversely proportionally equal to the amount of processing that a task requires to be completed and the amount of conflict that needs to be handled during processing*.[172]

---

[171] Nonaka, Toyama and Nagata. 2000, p2

[172] Boisot. 1998, p44

Codification as a process sheds surplus data by making a choice to disregard alternative data that is deemed irrelevant; this process in effect reduces uncertainty.

Boisot says that the codification of knowledge assets requires categories to be defined and that more than one category can be applicable to an item. Codification becomes complicated when many categories are defined and the number of possible codified positions increases exponentially with each category that is added. There are also the issues of clarity for the definition of each category to help with clearly categorising border line items. *Phenomena that vary discreetly are easier to codify than those that vary continuously.* [173]

Codification is the natural ability of knowledge agents to discriminate and associate data with sets of codes, categories or frames in order to make sense of messages that are stimulated by the environment. The ability to codify is a function of a knowledge agent's cognitive ability when its *Agent Knowledge* as depicted in Figure 4-1 is used to associate and discriminate data stimuli into categories in order to economise on the amount of data that needs to be processed in the sense making process.[174]

Boisot remarks that the ability of individuals to discriminate between categories in the codification process can be highly subjective and can vary in degree from human to human. The discrimination performed by an expert, someone with more training and experience, in a specific field will be much finer grained than that of someone with little experience:

> *The choice involved with codification links codification to complexity.* [175]

The act of codification requires the knowledge agent to choose between competing perceptual and conceptual alternatives. The more alternatives available the more complex such a task become because more data needs to be processed to produce a result. Codification also inevitably results in consequences due to a choice that has to be made for one option and against the alternatives. More alternatives available result in more potential consequences, which again result in higher complexity of the codification effort.

What is important regarding the degree of codification of knowledge assets for enterprise architecture is the extent to which the sets of codes and categories are aligned across the

---

[173] Boisot. 1998, p43

[174] Boisot and Yan. 2008

[175] Boisot. 1998, p44

knowledge processing agents. Boisot, McMillan and Han[176] show that a measure of alignment is required for different living systems (knowledge agents) to either collaborate or compete, based on messages received. These codes and categories, otherwise referred to as frames, are the product of the agent's prior beliefs and expectations. A dominant logic that is embedded in the organisation's culture will emerge if enough frames are shared across people in the organisation. The concept of knowledge agents making use of frames to embed prior knowledge can also be found in Weick's[177] discussion of sense making (see section 4.5), where frames are seen as the result of action by the knowledge agent on the environment, which in turn modifies the source of data extracted from cues and stored as knowledge.

This dominant logic is a double-edged sword as it can lead to group think and stagnation of the organisation's knowledge dynamics. Yet dominant knowledge, on the other hand is essential to ensure that messages that are communicated to knowledge agents are mostly interpreted in a similar fashion.

The enterprise architect needs to understand the sets of codes and categories that are associated with knowledge assets in order to understand what effect that they will have on the organisation. The categories can be either *crisp* or *fuzzy*[178], which will affect the way they are interpreted by the knowledge agents. In some cases codes and frames need to be modified by the architect or some other change agent to be appropriate for the enterprise architecture. In some cases it will not be possible or desirable to make changes to the categories and it will then become a constraint or guiding factor for the development of the enterprise architecture.

More codified objects have the ability to create a lock-in effect over time and this effect could be irreversible because it creates cognitive and behavioural commitment in the users.[179] Often knowledge asset can have competing knowledge codes and categories that can cause associated products being chosen by knowledge agents merely according to which set of codes or categories are more often used, and not their technical or epistemology superiority. Boisot describes the competition between the Betamax and VHS format for VCR and the competition between the IBM PC and the Apple Mac for computing as good examples of coding and category sets that succeeded merely by the fact that more videos were encoded in

---

[176] Boisot et al. 2008
[177] Weick. 1995, p118
[178] Boisot et al. 2008, p88
[179] Boisot. 1998, p45

VHS format and more computer programs were written for IBM PCs, despite the fact that Betamax and Apple Mac arguably have superior technical capabilities.

It also happens that established codes and categories can be exchanged or unseated for different sets of codes or categories because the replacement sets are simply technically or epistemologically superior. An example of this would be how the Hindu-Arabic numeral system was chosen by the Western world to replace the well-established Roman numerals. The Roman system, like others that are not based on the principle of position, does not provide an efficient and easy method of computation.[180]

Codification effectively allows economisation of knowledge assets by bringing them into the ordered regime, but has the trade-off of losing flexibility in the system and running the real risk of fossilising the process.

4.8.2 Abstraction

Abstracted knowledge assets refer to knowledge assets that have evolved into being conceptually relevant within a given context. It often happens that certain concepts in organisations have been abstracted in such a way that someone without the organisational context cannot comprehend the concept at all unless they are exposed to the organisational culture for a while.

> *Abstraction treats things that are different as if they were the same. In effect, abstraction, while preserving relevant information, erases the differences that make no difference.*[181]

According to Boisot abstraction *strongly relates to codification, where codification provides form to phenomena and abstraction provides structure*.[182] This structure is typically relevant to a specific context and loses meaning and value when it is removed from that context. Highly abstracted knowledge assets tend to be very relevant and valuable to the organisation to which they belong. The process of abstraction occurs naturally because *abstraction further economises data processing by reducing categories by associating cause-and-effect relationships between categories and combining categories in the process.* Boisot goes

---

[180] Source: Numeration systems and numbers. In Encyclopædia Britannica Online School Edition, 2009 Compton's by Britannica, [Online] Available: http://school.eb.com/all/comptons/article-205800.

[181] Boisot et al. 2008, p91

[182] Boisot. 1998, p90

further to show that abstraction consciously reduces some of the data processing by assuming (based on consumer knowledge) that the consumer will do some of his or her own data processing. The level of abstraction of knowledge assets is directly related to the knowledge asset's range of applications and circumstances.

Any knowledge asset that is introduced into an organisation needs to be abstracted into the context of the organisation in order to unlock relevant value and be useful as an agent that will reduce data processing. Boisot states that *when properly carried out, abstraction allows one to focus on the structure, causal or descriptive, that underlies the data. It generates concepts rather than precepts*. [183]

Abstraction, like codification is a device for shedding data. *Codification facilitates abstraction by giving categories an edge, and by making them more visible and easier to manipulate. Abstraction is turn, stimulates codification by reducing the number of categories whose boundaries need defining. Both working together have the effect of making knowledge more articulate and hence sharable.* [184]

Abstraction reduces codes and categories by treating objects that have differences in certain categories or codes as the same, because the differences are of lesser or no importance even though they are perfectly valid. The decision regarding the importance of the categories and codes is made within a certain context and will most likely be relevant only within that context. The result is a compact set of categories and codes that will allow more efficient data processing, which by implication consumes fewer resources and have increased value.

The enterprise architecture, as an example of a knowledge asset, needs to be properly abstracted to have value to the organisation. A properly codified and abstracted enterprise architecture that has been modelled and/or encapsulated into an architectural blueprint has immense value to the organisation as it provides a basis for technology solutions to be implemented with less effort. The enterprise architecture provides a common basis for all technology solution from which relationships, dependencies and constraints for the solution can be derived.

Abstraction and codification strategies across groups of knowledge agents are shared in the culture of the group; this results in conventions that facilitate a shared alignment and common

---

[183] Boisot. 1998, p50
[184] Boisot. 1998, p55

interpretation of data through cognitive processes. Knowledge processing agents always have partially overlapping knowledge sets, because these knowledge sets are a result of a knowledge agent's particular experiences and will therefore always extract different information from the same data because of different codification and abstraction strategies.

A knowledge agent's experience base changes continually, which results in dynamic codification and abstraction sets and strategies. This is what makes the capturing and management of knowledge assets such a challenging and complex exercise, even though knowledge assets are likely to be among the most important assets of the organisation. Enterprise architecture can only hope to understand and influence the organisation's knowledge assets and, most importantly, to leverage off the advantage that they are likely to provide. Boisot, McMillan and Han conclude that *epistemic heterogeneity, as a result of the dynamic nature of codification and abstraction, is a source of competitive advantage for an organisation.* The only way in which a competitive advantage can be sustained is ensuring a fast-learning organisation with the ability to deploy codification and abstraction skills that are both flexible and rapid.

4.8.3 Diffusion

Knowledge assets only have value to the organisation when they are accessible to be used by the people in the organisation. Diffusibility establishes the availability of data and information for those who want to use it, but this does not ensure adoption: information may be widely diffused and yet remain unused.[185]

The architect needs to consider the diffusibility of knowledge assets when designing and managing the knowledge as part of the enterprise architecture by taking the following into consideration:

- The sensitivity of the information, data or knowledge that is embedded in the knowledge asset and how widely it should be made available
- The level of abstraction and codification that is embedded in the knowledge asset that would make it suitable for consumption by an intended audience.

[185] Boisot. 1998, p52

When used in the I-space, the given population can be determined, based on requirements for the analysis. A population located on the diffusion scale of the I-Space has to constitute a potential audience for a message or set of messages being transmitted.

Diffusion does not imply that senders of the message want data to be transmitted to all potential data-processing agents or that all the agents necessarily want to or have the capacity to decipher the messages.

For messages to lead to the desired effect, a sender and receiver must share more than just coding schemes; they must share compatible orientation, i.e values, attitudes and motivation.

The considerations that affect the trajectory of knowledge asset diffusion are[186]

- the available means of communication that will establish the nature and means of technical problems,
- the sharing of codes between senders and receivers that will reduce the semantic problem but will require a joint investment in the communication nexus (a connected group or series) prior to any specific communicative acts,
- the prior sharing of context between the sender and receiver that will ease the pragmatic problem between sender and receiver by ensuring a better alignment of mutual expectations – it will require a prior investment in shared experiences that may sometimes far exceed whatever investment is required by sharing of codes,
- the speed at which a message is diffused in a population will partly be a function of the rate and intensity with which agents interact with each other; face-to-face interactions will require spatial density and electronic communication will require frequency of interaction,
- the traditionally assumption that information diffuses faster within urban than rural populations, due to the difference in special density,
- the cultural disposition that will select messages likely to diffuse rapidly and which are likely to be ignored,
- legal considerations that may affect the diffusion of information.

---

[186] Boisot. 1998, p54

4.9 Exploring Knowledge Assets dynamics in the I-Space

It is important to have some kind of framework or tool to use in order to establish a link between Knowledge Assets and Enterprise Architecture. Boisot[187] specifically developed the I-Space framework in order to explore the dynamics of Knowledge Assets. It is possible that several other frameworks exist that could be used to equal or better effect for the architecture of knowledge assets but such an exploration is beyond the scope of this research. Use of a framework greatly depends on the context and circumstances within which Enterprise Architecture is done. It is for that reason that this research cannot be descriptive about the tools and frameworks used when Enterprise Architecture is performed within the knowledge asset space.

Boisot uses the conceptual framework, the Information Space (I-Space) to examine knowledge assets. He writes that:

> *this allows us to examine the flow properties of information within different agent groupings as a function of its degree of codification and abstraction.* [188]

Boisot presents the I-space as a,

> *….conceptual framework within which the behaviour of information flows can be explored and, through these, the creation and diffusion of knowledge within selected populations can be understood.* [189]

Boisot presents the I-Space as a three-dimensional cube (See Figure 4-8) using each of the dimensions to represent degrees of codification, abstraction and diffusion.

---

[187] Boisot. 1998

[188] Boisot. 1998, p41

[189] Boisot. 1998, p55

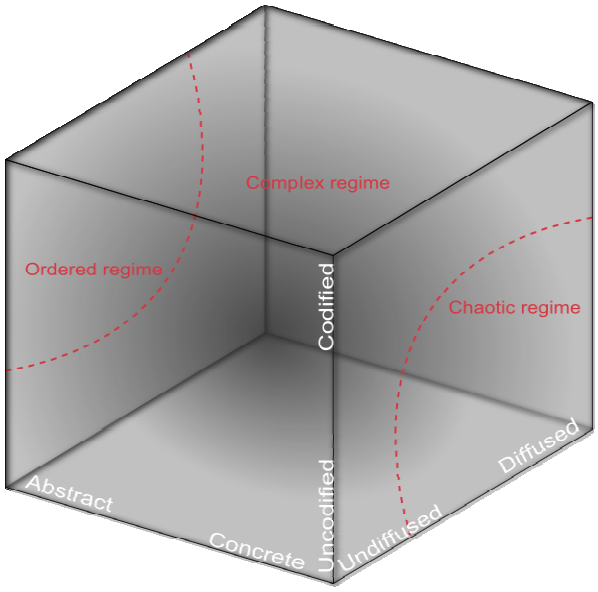


Figure 4-8 The I-Space

(Source: Boisot, 1998)

Some of the basic properties of the I-Space as described by Boisot[190] will be discussed in order to provide some context and orientation within the I-Space. These properties will also be used to tie the previously discussed topics regarding knowledge assets together as a conclusion for this chapter.

The creation and spreading of new knowledge is a dynamic process that activates all three dimensions of the I-Space. In broad terms, knowledge moves though certain zones in the I-Space along a predominant path, which oscillates between the different regimes of the I-space; these regimes correspond to those of the evolutionary production function depicted in Figure 4-5.

Boisot describes the I-Space regions in the following way:

- The ordered region is the region where the information is at its *most codified and abstract level and diffusion is under central control*. [191] It is at this level that the entropy of information is at its lowest level. Generally, the strategy of organisations is to move

[190] Boisot. 1998
[191] Boisot. 1998, p69

information into this regime where information is very ordered and its competitive advantage can be pursued.

- The chaotic regime has properties opposite to that of the ordered regime. Information in this space is highly diffused, very concrete and has a low codification. *In this region data can be given no structure and its diffusion in the social system is pervasive and quite random.* [192] At this point entropy is at its highest.
- It is within the above-mentioned regimes that the regime of complexity can be found. Boisot describes this as *a state of the world intermediate between chaos and excessive order.* [193] This space can otherwise be described as a space at the edge of chaos.

Figure 4-9 illustrates the knowledge type which depends on the degree of abstraction, codification and diffusion within the I-Space.

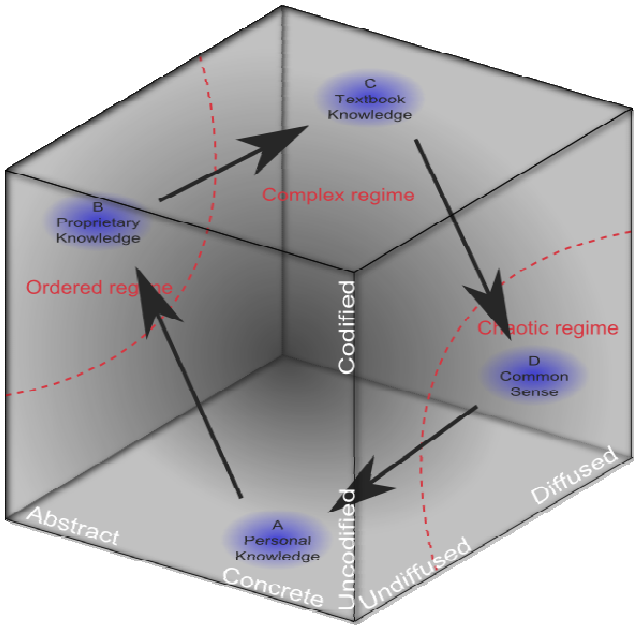


Figure 4-9 The movement of knowledge in the I-Space

(Source: Boisot 1998)

According to Boisot the knowledge zones refer to the following: [194]

---

[192] Boisot. 1998, p67
[193] Boisot. 1998, p67
[194] Boisot. 1998, p58

- Personal knowledge, described as *highly personal idiosyncratic knowledge of particular events*which is of a tacit nature. This knowledge is highly concrete an uncodified and deeply embedded in the mind of the owner of such knowledge.
- Proprietary Knowledge – in order to derive value and exploit personal knowledge, the interactive cycles of structuring will be applied to the knowledge, which will shed its tacit concrete particulars and gain in generality; this knowledge can then be represented as proprietary knowledge and is often protected by patent and copyright laws.
- Textbook knowledge – in time proprietary knowledge moves to the public domain as it becomes diffusible as public or textbook knowledge; this knowledge can be found on websites, entertainment media programming, manuals, White papers, laws, articles and any other publicly consumable source of knowledge.

Common sense – as textbook knowledge becomes internalised into the collective consciousness of a society or group, it becomes what is referred to as *common sense*. Internalisation occurs by means of applying the knowledge for different solutions, thus embedding it in the collective knowledge base of a specific cultural context.

4.9.1 The social learning cycle

In presenting the I-Space Boisot states that,

> *….it is possible, for example, to think of the relationship between codification, abstraction and diffusion as setting up a data field, a configuration of forces that condition data flows over time through the I-Space and hence help to shape the evolution of knowledge assets; data is indeed constantly on the move in the I-Space – much uncodified data sooner or later gets codified, much concrete data gradually increases in abstraction, and data that was the proprietary possession of a few individuals gradually becomes the common possession of all.*
>
> *Movement in the reverse direction is equally likely; codified data in time gets internalised and becomes tacit, abstract data gets applied to concrete problems and diffused data gives rise to unique insights which are appropriated be well-placed individuals.* [195]

[195] Boisot. 1998, p58

According to Boisot, a predominant sequence of the Knowledge Asset lifecycle, which he terms the Social Learning cycle, occurs in six phases[196]. The social learning cycle is depicted in Figure 4-10.

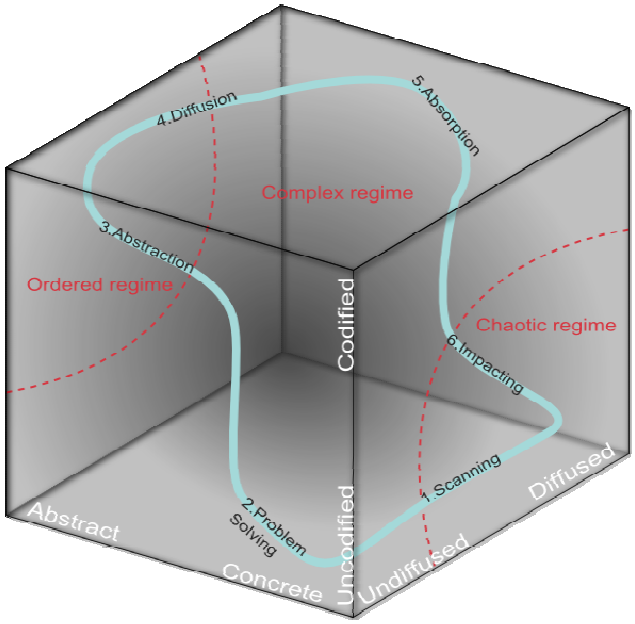


Figure 4-10 The social learning cycle (SLC)

(Source: Boisot, 1998)

Scanning is described as *identifying threats and opportunities in generally available but often fuzzy data.* The speed of scanning depends on how well codified the data is, because well-codified data is easier to scan. Boisot describes the knowledge at this stage as being in the *possession of individuals or small groups*. This process makes use of inter-subjective sense making as discussed in Section 4.6. Knowledge assets are created through making sense of the day-to-day activities and ongoing events to which the knowledge agent is subject.

Epistemologically the act of scanning is what moves knowledge assets from the possible world into the probable or plausible world as described in Section 4.7.

In the Evolutionary Production function depicted in Figure 4-3, the motion of scanning moves in the direction of A to A′, but operates mainly in the chaotic regime, close to A, where not much meaning can be attached to the insights produced by the scanning phase yet.

---

[196] Boisot. 1998, p59-61

Enterprise Architects perform this type of scanning on a continuous basis. They generally need to scan and extract cues from the environment where they operate when they are attending meetings, reading documentation, interacting with stakeholders and any other conceivable area where the environment could provide possible cues that need to be internalised by the architect. The knowledge usually possessed by the architect could be in various stages of codification but will probably be applied to a concrete problem.

Problem solving. Boisot states this phase as a *process of giving structure and coherence to such insights* that were derived during the scanning phase. This process is largely one of codification where a *definite shape* is created for the knowledge, reducing some of the uncertainty surrounding the knowledge asset.

This phase makes use of *generic subjective sense making* as discussed in Section 4.6. This kind of sense making, as Weick states, is the dominant process in organisational sense making. This process takes place when the extracted cues from the scanning stage are elaborated upon by the knowledge agent's current frames to create meaning for the organisation.

Epistemological problem solving continues to strengthen the knowledge asset's position in either the plausible or probable worlds. During problem solving the knowledge asset will move closer to the centre of Figure 4-7 i.e. towards the actual world.

The movement of data vs. physical factors on the evolutionary production function (see Figure 4-3) is in the direction of A to A′. As more data is generated on the problem, the ability to consume fewer physical resources becomes possible, moving the knowledge asset from a chaotic state into a state of complexity.

Enterprise Architects spend a significant portion of their time in the problem-solving and abstraction phases of the SLC. Evidence of knowledge assets being in this phase can mostly be seen when Enterprise Architects have discussions with their peers, managers and colleagues from project teams, attempting to resolve issues and architect new solutions. The problem at this stage is still very concrete, yet higher codification increases shared meaning in the organisation regarding the problem.

Abstraction. This phase *generalises* the recently codified knowledge assets so that it can be applied to other problems and issues as well. This involves reducing them to their most essential feature - i.e., conceptualising them. Abstraction and problem solving often works in

tandem, according to Boisot as certain types of codification is needed to probe the abstract environment.

Knowledge assets in this phase move into a propriety state, as shown in Figure 4-10. This movement also signifies the movement into the actual epistemological domain as shown in Figure 4-7.

Knowledge Assets that are abstracted move into the ordered regime on the evolutionary production function towards A′ in Figure 4-3 and this is considered by organisations as being the pinnacle of existence for a knowledge asset where the economisation of data processing is at its optimum.

Epistemologically abstracted knowledge can be expected to be close to or within the region of actual knowledge as depicted in Figure 4-7. This signifies knowledge that has both been justified in context of other knowledge and has been made plausible within the organisation's cultural context.

Both generic subjective and extra-subjective sense making could be at play in this phase. Generic subjective sense making will assist in generalising the knowledge asset to its most essential feature and extra-subjective sense making will reduce the knowledge asset to its most generalised and essential feature.

Being able to properly extract knowledge assets is considered to be an essential capability of an Enterprise Architect. Abstraction occurs when knowledge assets create systems strategies and guidance in the form of target architectures.

Diffusion aims at strategies to *share the newly created insight with a target population.* Boisot states that it is easier to share well-codified data with a targeted population and that the speed and effectiveness of the sharing of data depends on whether the target audience have a shared context with the sender of the message. The size of the target audience has a direct bearing on the probability that a message can be shared successfully. The larger the audience the less probable is it that the message will be shared successfully.

Data at any stage of the SLC depicted Figure 4-10, from problem-solving to abstraction can be shared with an audience event though the figure indicates the diffusion of highly abstracted knowledge that would be close to the A′ in Figure 4-3.

Data higher up on the evolutionary production function and closer to A′ are merely easier to share, and the assumption is made that any effort to share information with an audience will result in the sender of the message to diffuse data closer to A′ than not.

Likewise from an epistemological point of view, is it expected that actual knowledge, as depicted in Figure 4-7, will be easier to diffuse than knowledge that is merely plausible but has no justification or is merely justified but does not seem plausible to the organisation.

Data which has been shared in the diffusion stage will move into the Textbook Knowledge domain according to Figure 4-9. Creating textbook-type knowledge requires the use of extra-subjective sense making as described in Section 4.6, which means that the information diffused is stripped from the *generic self* and replaced by *pure meaning*. An important observation to make is the fact that pure meaning represents the extreme of a spectrum of meaning, with the generic self being highly prevalent in the message that is being diffused, being on the other end of the spectrum. The knowledge agent who is diffusing the message will decide, based on the size of the audience and the shared context of the audience, to what degree the message will be pure meaning only.

The Enterprise architect creates many knowledge assets for the organisation that eventually need to be diffused to the organisation. These knowledge assets will likely be in the form of an architectural artefact representing the architecture for a specific project, which will contain more generic subjective meaning, to a published paper that will contain extra-subjective or pure meaning.

Absorption. Newly codified knowledge gets applied during this phase when knowledge agents *learn-by-doing* or *learn-by-using.* The codified knowledge that is absorbed during this phase will acquire some context from the uncodified experience within which it will be applied to provide insights for the circumstances where the application of the knowledge occurs.

Knowledge in this phase is embedded in the minds of the knowledge agents, usually through the process of inter-subjective sense making. The newly codified knowledge will be applied to the day-to-day occurrences, where the knowledge will over time be embedded into their actions, thoughts and culture.

The absorption of knowledge is that part of the process where knowledge is likely to mover from A′ to B in Figure 4-3. It is difficult to manage and predict this movement in the

knowledge cycle as the people to whom this information will be diffused cannot be forced to use and embed it.

The process of absorption will, through the inter-subjective sense making process, start to combine the knowledge assets, epistemologically now in the actual domain of Figure 4-7, with knowledge which has been in the justified, plausible and even probable domains through the exploratory process of sense making where knowledge agents will *create, preserve and implement the innovation that arises from intimate contact*[197].

It is important, for the Enterprise architect to ensure that the knowledge assets being created are well understood within the cultural context of the environment within which it should be absorbed. The creation of a textbook-based plan that has not been properly contextualised within the business environment where it is supposed to operate, will be more likely to fail than a plan with terminology and activities which are familiar to the business.

Impacting is the final *embedding* of the abstracted knowledge in *concrete practices* according to Boisot. He further states that absorption and impacting are likely to work in tandem; impacting occurs when the abstracted knowledge assets become concretely embedded in *artefacts, technical or organisational rules, or in behavioural patterns.*

The main difference between impacting and absorption is that absorption is the process whereby knowledge is internalised and embedded into the knowledge agent's minds and impacting being the enactment of such knowledge into the wider organisation. Impacting is the result of generic subjective sense making and applies to the roles within the organisation.

The impacting phase impacts on the organisational culture and is visible in the way things are done and what people say.

It is at this stage of the SLC that the architect becomes responsible for the governance that ensures that the intended abstracted knowledge from the abstraction phase impacts on the organisation in the intended fashion. This is done by formal governance activities performed by the Enterprise architect and also through the scanning process, where potential problems with the abstracted knowledge can be extracted and refined through the SLC.

The I-Space, as illustrated above, can be used to demonstrate the concepts regarding knowledge assets that have been discussed in this research up till now. The next chapter will

---

[197] Weick. 1995, p72

use this framework to discuss Knowledge Asset Architecture within an Enterprise Architecture context.

Chapter 5

Knowledge asset architecture

5.1 Introduction

The traditional concept of an architect is someone responsible for the design and building of buildings and other structures - it has always suggested a multi-facetted role. Architects are traditionally responsible for the process of planning, designing and building buildings to meet a set of needs and expectations. The architect also needs to understand the art of designing spaces that are practical yet exhibit flair and are often an expression of art.

Enterprise architecture can similarly be described as a multi-facetted practice, responsible for planning, designing, building and effecting change in organisations in order to ensure effectiveness, efficiency and competitiveness. Enterprise Architecture can be contextualised in various ways depending on the meaning of the term within the given context:

- Enterprise Architecture is firstly a **practice** that requires and involves skills *(the capacity to act)* and the ability *(the capability to act)* to repeatedly perform tasks associated with the practice.
- At the same time it is also a **discipline**, as a person can learn the skill to perform tasks associated with the practice of enterprise architecture.
- Enterprise Architecting is also a **verb** i.e. something that someone or a group of people can be doing at a certain time
- Enterprise Architecture is also a **process,** with a sequence of activities working towards a goal
- Enterprise Architecture can also be described as a **role** with associated accountabilities and responsibilities within an organisation
- Enterprise Architecture is also an **artefact** within the business that describes the business in terms of a current and future state.

- Enterprise Architecture can also be seen as a **competency** required within an organisation to plan, design and effect change in the organisation enabling it to achieve its goals and objectives.
- Enterprise Architecture is also often described in terms of the **frameworks** described in Section 3.2.

Knowledge Assets residing within the organisation are seldom objects that fulfil the single function of being a *knowledge asset* only. The definition of a knowledge asset as defined by Boisot states:

> *Knowledge assets can be thought of as that subset of dispositions to act that is embedded in the individuals, groups or artefacts that have value-adding potential.* [198]

The fact that knowledge assets are embedded in individuals, groups and artefacts implies that Knowledge Assets form an existing dimension in the objects and people that is used within the Enterprise Architecture. Knowledge Assets in other words have always been embedded within the Enterprise Architecture and those performing roles of Enterprise Architecture intuitively know and understand this already. It can even be hypothesised that Enterprise Architects have been performing knowledge asset architecture all along, yet very little evidence is visible in the frameworks and artefacts used and produced during the Enterprise Architecture process because of the embedded nature of knowledge assets.

This raises the question: why should Knowledge Assets be considered as a dimension of Enterprise Architecture when it is already embedded in the objects within the organisation that form part of the Enterprise Architecture?

To answer this question one has to consider the fact that the dynamics of Knowledge Assets, as described in the previous chapter, will affect the behaviour of objects that are the subject of, or related to the Enterprise Architecture. It is therefore an integral part of the Enterprise Architecture and should be considered a formal dimension of the objects embedded in the Enterprise Architecture.

---

[198] Boisot. 1998, p20

5.2 The relationship between Enterprise Architecture and Knowledge Assets

An organisation's Enterprise Architecture has knowledge assets embedded in itself, thus adhering to the properties of Knowledge Assets and is influenced by the related Knowledge Assets within the organisation, in turn influencing related Knowledge Assets in the organisation.

The organisation's enterprise architecture itself contains an embedded dimension of Knowledge Assets because it places the organisation at a disposition to act in order to realise its strategy.

The Enterprise Architecture interacts with other knowledge assets by

- taking them into account as items that influence and shape the organisation and enterprise architecture, and
- architecting knowledge assets by understanding, planning, changing and associating them with other items in the organisation, eventually forming part of the holistic architecture of the organisation.

An example of how Enterprise Architecture, with its embedded knowledge assets, interacts with different Knowledge Assets can be observed in the interactive influence that the organisation's strategy, itself containing embedded knowledge assets, and the enterprise architecture have on each other.

The organisation uses its strategy to define how it is going to act in order to achieve specific objectives. Mintzberg et al [199] argues that strategy is *plan*, *pattern*, *position*, *perspective* and *ploy*. The strategy of an organisation puts the organisation at a disposition to act in an expected/intended way in order to achieve a specific set of goals. The enterprise's architecture extends the strategy as it provides enablers that will leverage the information and knowledge assets of the organisation by putting in place people, processes and technology that would enable the achievement of the strategic objectives and goals.

The organisational strategy, from this perspective, is a Knowledge Asset that contains knowledge on how the organisation ought to react. The enterprise architecture in turn enables the realisation of the strategy and in effect is an extension of the strategy, thus influenced by

---

[199] Mintzberg et al. 2005, p9

the strategy through a complex set of relationships and interactions; chief among these would be the strategy's dictation of focus and scope of the enterprise architecture.

The enterprise architecture in turn informs the strategist of the organisation's capabilities and abilities due to the fact that the enterprise architecture aims to understand the components of the organisation and their relationships to each other.

The enterprise architecture process will give rise to deliverables with embedded Knowledge Assets in turn. The processes and technologies, put in place as part of the architectural and project/product/service/offering delivery cycle, should enable the organisation to achieve its strategic objectives (intended strategy). Processes and technology solutions in the form of information systems have embedded knowledge assets in various forms that influence the organisation's knowledge assets through a complex set of interrelated relationships. It is these relationships that the enterprise architecture aims to embody, understand and shape.

Knowledge Assets are dynamic and complex in their relationship with each other and this provides a completely different view of organisational dynamics than the traditional *connect-the-dots* view. It is this difference that makes Knowledge Asset architecture a significant tool to enable the organisation to deal with its emergent strategy.

5.3 The traditional approach to analysis and design

Traditionally, the approach used by information management professionals for the analysis and design of information technology solutions, involves analysis of the organisation's information and data flows in an attempt to understand the information requirements that will assist the organisation in solving a problem or gain efficiencies in the processes.

Various authors have asserted that the objective of information systems should be *providing the right information to the right person at the right time*[200]. For this objective to be met, an information provider will have to know in advance what the right time and the right person is, identify the problem in advance so that the information needed at that moment can be supplied. This approach assumes the ability of all the factors to be known and analysed in advance and that a clear, compartmentalised view of the organisation can be assembled where everything is known.

---

[200] Govindasamy. 2001, Malhotra 2001, p206, Petrash 1996.

Experience gained from information system implementations however tells a different story: the success rate of information system projects world-wide are not at satisfactory levels, with more or less 20 percent of all projects being cancelled before completion and less than a third finishing within time, budget and expected functionality[201]. An underlying factor to this problem is the fact that designs and architectures for these systems assume that complete and prior knowledge of the environment will be gained through analysis. Assumptions are made that the environment and scope will remain mostly stable.

The I-Space, which can be used to represent the complete scope of data and information found in the context of the organisation (Figure 4-10), clearly shows that data will be in the ordered, complex and chaotic regimes at different phases of its existence. Chaotic and complex systems cannot be analysed in the same way that ordered systems can be analysed. It does not matter how many times the system is analysed, the analyst or architect will always work with some uncertainty, due to the fact that cause and effect patterns break down in this environment. Snowden has the following to say about complex systems:

> *A complex system comprising many interacting identities in which, while I cannot distinguish cause and effect relationships, I can identify and influence patterns of interactivity.* [202]

The traditional approach suggests the reduction of complexity by breaking the system into simple components, which could then be analysed. The problem with this approach is that with complex systems that sum of the simple components does not add up to the original complex system. Or, in other words, once a complex system has been disassembled it cannot be restored to its original state by re-assembling. Cilliers explains it best:

> *I have heard it said (by someone from France, of course) that a Jumbo jet is complicated but that mayonnaise is complex.* [203]

Cilliers further explains that,

> *….the interaction among constituencies of the system and the interaction between the system and its environment are of such a nature that the system cannot be fully understood simply by analysing its components. Moreover these relationships are*

---

[201] Kappelman, McKeeman and Zhang. 2006, p31

[202] Snowden. 2002, p105

[203] Cilliers. 1998, p3

> *not fixed, but shift and change, often as a result of self-organisation. This can result in novel features, usually referred to in terms of emergent properties.* [204]

Clearly a new way of architecting and designing IT systems is needed to cater for the uncertainty encountered in the complexity of the organisation. Knowledge Assets are very well situated within the organisation to assist enterprise architects to cope better with the above-mentioned uncertainty. The following reasons support this stance:

- Knowledge Assets are directly linked to the disposition of the organisation to act. The organisational activities are what ultimately determine success or failure within the organisation.
- Knowledge Assets are embedded in all information-bearing objects in the business, including people, documents, policies, cultures and information systems
- Knowledge assets are representative of objects that exists within the ordered, complex and chaotic regimes, thus spanning the complete scope of system regimes.

Understanding the role that Knowledge Assets play within the organisation, how they interact with each other, how they influence the other aspects of the organisation and how they interact with entities outside of the organisation, will create a completely new level of understanding which can be applied to the enterprise architecture. The enterprise architect should be able to use this knowledge to not only plan better, but to be able to better understand which areas of the business are complex and riddled with uncertainties. Knowledge Asset architecture together with the tools and methods applied to complex adaptive systems, will enrich the architect's ability to create more resilient and agile solutions for the organisation.

5.4 Defining Knowledge Asset Architecture

The architecture of Knowledge Assets has many similarities with architecture in the business, information and technical domains, but there are also some significant differences from these.

The way in which it corresponds with other domains of the enterprise architecture is mainly the fact that, as with business, information and technical architecture, it is very much a view of the complete enterprise architecture. Knowledge Assets do not stand separate but are

---

[204] Cilliers. 1998, p4

embedded in the data, technology and business process, which form the subjects of the other domains of the enterprise architecture.

Knowledge Asset Architecture is also different from other domains in the enterprise architecture because Knowledge Assets form part of the fundamental components of the organisation and are embodied in its components and have relationships across architecture domains and the organisation's external environment and likewise need to adhere to the principles that govern and design the organisation's evolution.

The TOGAF frameworks describe the role of the architect as

> *having the responsibility for ensuring the completeness (fitness-for-purpose) of the architecture, in terms of adequately addressing all the pertinent concerns of its stakeholders; and the integrity of the architecture, in terms of connecting all the various views to each other, satisfactorily reconciling the conflicting concerns of different stakeholders, and showing the trade-offs made in so doing.*[205]

Rebentisch and Ferretti define Knowledge Architecture as a *characterisation of the structure and the artefacts into which knowledge has been embodied in the organization, and (which) describes the way an organization stores and processes information.* [206]

It should be the role of the enterprise architect to understand the organisation's knowledge assets and how they are linked to and embodied in the rest of the organisation's architecture. The architect will plan enablers for deriving value from knowledge assets and use knowledge assets to the advantage of other forms of architecture in the sense that it will for instance use knowledge assets in context of the data architecture to ensure complete and relevant information architecture.

Knowledge assets are embedded in various aspects of the organisation and have different types of characteristics depending on the context within which they are embedded. Knowledge assets are typically embedded in all the stakeholders of the organisation including all the employees (management and those at the coal-face), shareholders, customers, suppliers, regulators and all other involved parties. Collectively this knowledge is embedded

---

[205] Harrison. 2007, p164

[206] Rebentisch and Ferretti. 1995, p10

into the organisation's culture, as described by Boisot[207], and is ultimately manifested in the behavioural elements such as politics, processes and collective meaning, as described by Fiol[208]. Knowledge assets are embedded in cognitive processes on different levels and are often expressed in process models and organisation structural models.

Knowledge assets are embedded in the organisation's explicit content which might be formal like policies, directives, position papers, blueprints, strategies, reports and governance and informal content like blogs, documented frequently asked questions, socially collaborative software like chat rooms and peer-to-peer applications like video conferencing and even externally based social communities.

IT systems have embedded in them relational data structures, application functions and physical networks and other technology that allows them to interact with human stakeholders of the organisation and each other. Knowledge assets are embedded in the rules, relationships, objects and messages that flow through and between these systems, whether they are internal to the organisation or are external to them.

The architecture of knowledge assets however requires a new way of thinking when an architecture approach is applied. It is not possible to design and manage knowledge and knowledge assets in the traditional sense, due to the complex nature of knowledge and the fact that it is intangible and personal to the knowledge processing agent. Even though this makes it more difficult to understand it is exactly this capricious nature that is of interest to the enterprise architect.

This view is corroborated by Allee when she states that

> *people working in the intangibles arena, including knowledge management, inappropriately apply traditional business methods, tools, and frameworks to intangibles. This fundamentally different understanding of business and economic activities requires new approaches.* [209]

Allee[210] also mentions that modelling business and enterprise from a living systems perspective requires being able to

---

[207] Boisot. 1998, p117
[208] Fiol. 1991, p208
[209] Allee. 2002, p2
[210] Allee. 2000

- identify its pattern of organization as an organization
- describe its structure, and
- discover its most critical processes or exchanges from both a cognitive perspective and the flow of energy and matter.

For example, when considering knowledge assets in the enterprise architect space, the architect might need to consider the importance of external social networking sites like Facebook, Twitter and Ning-sites and their effect on the organisation from an enterprise architecture point of view. A few of the dimensions that architects are likely to consider are concerns around productivity where employees might use the application during work time which might be deemed unproductive. Another cause could be the effect that usage of these applications could place an additional load on the information technology infrastructure, like the additional load on the internal and external network due to the additional network traffic created by these applications.

From a knowledge asset perspective there might be experts within the organisation and external to the organisation that might be collaborating in a virtual community of practice[211] that could bring very valuable knowledge to the organisation by means of using the social networking applications. Customers and other stakeholders will most certainly be part of the social networking community. There is a real danger that business opportunities could be lost when employees' access to social networking sites will be denied. Potentially the organisation will be partly blocking the diffusion of information that flows outside the organisation and also blocking the ability of employees to scan diffused information outside the organisation. Blocking of the diffusion phase in the context of the SLC as depicted in Figure 4-10 has the potential of negatively affecting the subsequent phases of absorption, impacting and scanning. Blocking the scanning phase as depicted in Figure 4-10 can block the entry of new knowledge into the organisation.

Thinking about the knowledge assets in an enterprise architecture context will help to make an informed decision regarding social sites other than the response on productivity, information security and load on the technology. Deciding to block the social site might well be a valid response, but then the decision should be taken with all the implications in

---

[211] Wenger. 1999

perspective and not just from an information security or productivity point of view. For organisations that handle extremely sensitive information like patents or national secrets, the strategy of blocking the diffusion of information in this manner is a valid decision. Organisations on the other hand that need to continuously improve and drive efficiency will likely disadvantage themselves by blocking its employees' ability to scan for new ideas in the social networking space.

5.5 The value of knowledge assets architecture

Information only has value to the organisation when the message that is provided is accurate, relevant and meaningful for the agent who needs to consume the information and it causes the agent to act a way that adds value. The focus of information technology in general is to be a provider of information that is accurate and of good quality, but primarily does not concern itself with the question of relevance and meaning, nor concerns itself with the actions of the relevant agent. Understanding how knowledge assets are associated with provided messages will enable the information processing agent to frame and contextualise the message and derive sustained value from the message.

Boisot places emphasis on the fact that knowledge assets are sources of competitive advantage for firms. Knowledge asset architecture is important for the organisation because simply possessing and stockpiling knowledge asset does not automatically translate into profits. To quote Boisot:

> *Clearly, competitive advantage does not flow automatically from the possession of knowledge assets. A firm has to know how to extract value from them.* [212]

Information theory and information technology have traditionally been approached from an engineering perspective that does not concern itself with the semantics and meaning of the message but rather with the accuracy of the resultant message. Boisot et al.[213] show that, according to Shannon, the communication of information is a three-tier problem:

- The first problem is *technical*, ensuring that the message that is received is true to the message that was sent.
- The second problem is one *semantics*, and

---

[212] Boisot. 1998, p70

[213] Boisot et al. 2008, p28

- The third problem is concerned with whether a given message has the desired effect on a given message destination, in other words the *effectiveness of the message*.

Shannon[214], widely regarded as the father of information theory states in a 2001 reprint of a 1948 article that:

> *….the fundamental problem of communication is that of reproducing at one point, either exactly or approximately, a message selected at another point. Frequently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem.*

Boisot MacMillan and Han[215] show that messages are made up of sets of symbols and that these symbols could come into existence in a number of ways. Spoken language came into being over an extended period through a process of discovery; it is ever changing, whereas a cipher with an encrypted message could come to being and exist in a short space of time specifically for the transmitting of that message. Information theory takes the symbol set to be transmitted as a given and does not concern itself with the origin.

The fact that enterprise architecture originated from enterprise technical architecture, as shown in Section 3.3.3, has the result of enterprise architecture mainly being concerned with the accuracy of the message delivered by the information system. This research proposes that enterprise architecture needs to concern itself with the intended meaning of the message for true value to be derived from organisational information and not just the accuracy of the message between target/receiver and source/transmitter.

Information can only have value if the message is not only accurate but also relevant, understood and meaningful. Information Oriented thinking has been linked by Marchand et al.[216] empirically to business performance by showing that a combination of good IT practices, Information Management Practices and Information Oriented behaviour are the keys to derive value from information. IT practices and to a large extent Information Management practices are concerned with the information theory problem of producing a correct and reliable transmission of data, but when combined with the key behavioural

---

[214] Shannon. 2001, p3
[215] Boisot et al. 2008, p24
[216] Marchand et al. 2001

aspects regarding information, relevance and meaning allow information to positively affect business performance.

Information attributes are patterns extracted from data which, when properly applied, have the ability to modify the behaviour of physical attributes and hence modify their rate of consumption of physical space and energy per unit of time. This capacity is called *knowledge*.[217]

Marchand et al[218] show that an information processing agent can derive value from information needs when he is comfortable that

- he can rely on the *integrity* of the information in the sense that it can be trusted and the principles by which it was produces are shared by the agent and the rest of the organisation,
- he knows the extent of *formality* of the information so that he can have confidence and comfort in the information,
- the information is in support of strategic objectives and *controlled* as such,
- even though the information may not be perfect, its underlying fabric is *transparent* to allow correction and a flexible change of course in order for strategy realisation,
- the information is underpinned by a disposition to be *shared*, embedded in the organisational culture and enabling toolsets which will lead to trust of the information due to the wider audience, and
- a sense *of proactiveness* of gathering and sharing the information.

Knowledge asset architecture then adds value to the creation of the enterprise architecture by concerning itself with the uncertainties and complexity that is associated with the meaning of the information, a dimension previously explicitly ignored by Information Theory. Organisational performance will be positively affected when the process of emergent meaning from organisational information and knowledge is enhanced in any way, because organisational knowledge is directly linked to what the organisation does (activity). Knowledge asset architecture will add value to the organisation by enhancing the processes

---

[217] Boisot. 1998, p25

[218] Marchand et al. 2001, p21

of emergent meaning locked up in the business processes, information and technology described in the enterprise architecture.

5.6 The Architecture of Knowledge Assets

As knowledge assets evolve and flow through the organisation, it constantly changes character and form. Knowledge assets in different states have different requirements, react differently and have a different effect and value proposition to the organisation.

Knowledge assets represent a very broad set of business entities and enterprise architects can hardly expect to be able to pinpoint every knowledge asset relevant to the organisation categorise, describe, govern, plan and design them to be of optimal value. Knowledge asset's nature of being complex and uncertain in many cases causes the scope of categories that will need to be dealt with to be vast. Their complex nature makes it difficult to pinpoint or describe and almost impossible to manage and plan because they are likely to change and evolve at every moment and the mere fact that they are being described could mean that they will change. Knowledge assets are in a constant state of flux and getting a design handle on them will be very difficult.

The enterprise architect needs to ensure that he confines knowledge assets to those that form part of the architecture to the problems being addressed. The aim should not be to have a complete grasp of all the knowledge assets that exist within the organisation as this will be confusing and nearly impossible. The enterprise architect needs to identify and create most of the relevant knowledge assets pertaining to the current problem set.

Understanding the knowledge assets can be achieved by describing the properties of knowledge assets in terms of the dimensions by which they can be recognised and then using these dimensions to show how they can be relevant to the architectural domain. Understanding how knowledge assets react in these terms, these dimensions will allow architects to make decisions regarding the knowledge assets, how they should be embedded, enabled, diffused and leveraged to the advantage of the enterprise.

5.6.1 Identification and creation of knowledge assets

In order to be able to *work* with knowledge assets in the enterprise architecture context the enterprise architect needs to either identify or create the relevant knowledge assets.

Identification of knowledge assets depends on the regime within which it exists:

- Knowledge assets in the *ordered regime* are the easiest to identify. They will be well known often located in a kind of repository like a library or database. They will be well codified and properly abstracted within the organisation and usually the result of generic subjective sense making. Architects and analysts following the traditional analysis and design approach usually are best trained to identify knowledge assets in this domain.
- Knowledge assets in the *complex regime* are much harder to identify. Methods for identification include techniques that allow for emergent properties of knowledge assets to be tapped. These kinds of knowledge assets are often locked up in opinions, attitudes and subconscious activities. An architect might want to listen for things said in conversations or make use of methods like Anecdote Circles[219] or Future Backwards[220] to identify and extract knowledge assets.
- Knowledge assets in the *chaotic regime* are the most difficult to identify. The total lack of cause and effect patterns necessitate the architect to have an ear to the ground approach, and then test the fruit of the identification exercise by experimenting with the results in different ways, being prepared to discard patterns that do not exists. Experimentation could involve something as simple as comparing the knowledge with other knowledge assets by sounding the ideas with someone who might be knowledgeable in the area. Another approach to deal with chaotic knowledge assets could be to immediately codify it by documenting the knowledge asset as a policy or directive, placing it in the ordered regime.

Knowledge assets can also be *created* by means of bringing knowledge into the domain of the problem that is being addressed. Note should be taken here that the argument is not for the creation of knowledge, but rather the creation of a knowledge asset, often from pre-existing knowledge.

Knowledge assets influence the organisation's disposition to act. It is possible, for this reason, for the architect, by means of scanning in the chaotic regime and then to codify, abstract and diffuse, to create a knowledge asset that would assist in the solving of the specific problem.

---

[219] Cognitive Edge. 2007a
[220] Cognitive Edge. 2007b

Knowledge assets that are identified can really be anything pertaining to the problem at hand and can amongst others take the form of an expert, leader, solution, IT system, policy, directive, white paper and any other means of affecting the way that the organisation acts.

5.6.2 The evolutionary state of a knowledge asset

Enterprise architects already consider knowledge asset's evolutionary state when they asses the maturity of products and solutions.

Typically technology based on recent developments is referred to as *bleeding edge* due to the high risk that is associated with the asset due to the lack of standard methods and proven application. These assets are in a chaotic or near-chaotic state and are marred with uncertainty even though there are lots of opportunities for high gains.

Leading edge products are better developed and are more likely to be in the complex state where up-take has been somewhat successful but the patterns that signify successful implementation are only visible after the fact. The markets will likely overflow with competitors in this knowledge area each with a different approach but little to no consolidation and standardisation is likely to be visible. Both the risk and cost of implementing such a solution are less than a *bleeding edge* product and this is the type of asset that should be obtained if the organisation has a high appetite for risk and want to distinguish itself from competitors with the latest and greatest.

State of the art products are *ordered state* products and have a high level of maturity associated with them. Competitors have consolidated into a few reliable and well-known entities and the industry is likely to be regulated and highly standardized. Costs are low and so are risks and every organisation that needs this functionality follows a standard approach with little opportunity for distinction. Boisot[221] calls these *dominant designs* in the evolutionary production function.

Products and services provided to the organisation are but one example of the evolution of knowledge assets. The organisation itself is likely to have knowledge assets that will be in various states of this evolution. It will be the role of the enterprise architect to identify these knowledge assets and as part of their holistic assessment understand their evolutionary state

[221] Boisot. 1998, p36

and how it affects the rest of the organisation. Enterprise architects might want to consider moving a knowledge asset into a different state where it can be better utilised or developed.

All knowledge assets do not necessarily have to move through the evolutionary process. Organisation culture, for example, by nature will almost always be in a chaotic or complex state because it is difficult for culture to exist in an ordered state as the links and patterns between elements cannot be definitely known but usually only observed in hindsight.

Certain types of knowledge assets can only be valuable in an ordered state and will have to be moved through the evolutionary process completely to an ordered state before their value can be exploited. This principle is visible in the pharmaceutical industry where breakthroughs are made on a regular basis through continuous efforts and investments but where products are not brought to market until all the standards and requirements have been met which society/government has placed as prerequisites. That means that pharmaceuticals cannot derive any value from a breakthrough before a product has been tested and experimental data has been gathered and analysed. The organisation has to go through all the pains of developing a product to an ordered (standardised and understood) state before it can become a market offering.

In the quest for productivity and control, organisations mostly resort to driving knowledge assets towards an ordered state. Very often organisations adopt strategies to, for example, move tacit knowledge that is possessed by individuals to an explicit state where it can be shared by other individuals and where it can be preserved after that individual has left the organisation. This is done because moving from tacit to explicit knowledge reduces the complexity of the knowledge and increases the *productivity* of the knowledge. Boisot[222] warns that organisations seeking *excessive order* reduce their capability to learn as there is little possibility to have the insightful learning that was described earlier on. Organisations like this run the risk of having their learning and subsequently their progress fossilised. The enterprise architect should ensure a healthy balance of knowledge assets in all phases of the knowledge asset evolutionary curve.

---

[222] Boisot. 1998, p39

5.6.3 Positioning on the Social Learning Cycle

Making use of the I-Space to conceptually understand the relative position of a knowledge asset within the enterprise architecture could be an effective tool to use. Knowledge assets can be assessed on their own, or in relation to other knowledge assets in close proximity to the problem being addressed.

Understanding where on the SLC curve the knowledge asset exists will enable the architect to determine in which regime the knowledge asset resides. The architect will also be able to determine the levels of codification, abstraction and diffusion of such a knowledge asset. Boisot states that,

> *….extracting value from knowledge assets requires an ability to manage them as they emerge, wax and wane through the actions of the SLC.* [223]

The architect needs to understand that the movement of information and knowledge through the SLC will incur costs in terms of data processing and transmission costs. Boisot suggest certain types of activities depending on where the knowledge asset exists in the I-Space:

- For *scanning*, weak signals need to be extracted from noisy sources within and outside of the organisation. Not only will the architect do research, attend conferences and liaise with subject matter experts, but he will also need to build relations with stakeholders and keep his ears to the ground in order to effectively scan the environment.
- P*roblem solving* involves the action of codification where variable size problems spaces are searched and risky selections are made amid conditions of uncertainty. One of the primary functions of the architect is to solve problems. Problems are seldom just solved in isolation, and the architect requires the skill to solve problems within the wider context of the organisation. Here the risk of the various tradeoffs is more significant as the solutions will reach over a wider area, impacting on more entities within the business.
- *Abstraction* involves the application of generic qualities associated to the problem that was solved in order to apply the solution to a more varied set of problems. This concept in TOGAF is called patterns. A *pattern* is defined as *an idea that has been useful in one practical context and will probably be useful in others.*[224] Architects are always looking

---

[223] Boisot. 1998, p70

[224] Harrison. 2007, p292

for ways to define these patterns in their architectures. When patterns are used, the solutions provided become more generic and alike. This in turn causes lower implementation and maintenance costs on solutions due to the fact that the same methods can be applied for patterns that are alike.

- *Diffusion* involves the communication of the data to varied audience sizes in a way that they can understand and respond to. Enterprise architects develop architectures which represent master plans or future states of information systems. Architects are required to communicate these plans to a variety of audiences, ranging from business sponsors, to project managers responsible for execution of the plan, to technical development staff, investment committees and business users. Enterprise architects also enable this process for the rest of the organisation when communications infrastructure and integrated systems are created as part of their target architectures.
- *Absorption* involves stimulating the recipients of the new knowledge to internalise and familiarise themselves with it. Architects are often intimately involved during the conceptual phases of the projects that need to implement their vision. It is during this involvement where the architect will guide the project teams and business users during the absorption process, addressing questions and responding to possible concerns.
- *Impacting* involves the application of the knowledge to concrete solutions. One of the roles that an architect has according to the TOGAF ADM[225] is that of governing and leading projects during the implementation phase of the architectural vision.

It is clear from this that enterprise architecture already in course of normal operation shows a close correlation with the steps of the SLC. The enterprise architecture that is developed is a knowledge asset that adheres to the phases of the SLC.

Boisot[226] identifies two types of learning that an organisation can employ in order to leverage the value from their knowledge assets. These learning types are crudely yet effectively described as the hoarding (*all knowledge is kept forever*) of knowledge assets, vs. the sharing (*only relevant knowledge is retained*) of knowledge assets. Boisot claims that organisations usually have a tendency to lean towards one or the other of these approaches when knowledge assets are managed.

---

[225] Harrison. 2007, p240
[226] Boisot. 1998, p95

Organisations employ the neoclassical approach to learning when knowledge assets are hoarded. In this approach the following properties can be observed:

- Knowledge assets are regarded as *cumulative*
- The process of learning consists of gradual elimination of errors in order to achieve better *quality knowledge*
- Knowledge assets *accumulate* in the memory of the organisation
- Well formed codification and abstraction approaches over time form *well tested* and *well integrated* knowledge assets
- *Hierarchically* based organisation of knowledge assets
- *Laws and procedures* governs the deployment of facts and lower level theories.

The neoclassical model provides a structured engineering type approach to the management and creation of knowledge assets. The approach is geared to providing perfectly bred good quality knowledge assets that are well organised and easily searchable. Unfortunately this approach could lead to a situation where an organisation is so blindsided by the sheer magnitude of its cumulative knowledge that it is unable to recognise that certain paradigms of knowledge have reached the end of life and have in fact expired. The validity of the complete knowledge base is then questioned and mistrusted and a once well-organised knowledge base can lapse into a state of chaos.

Organisations employ the Schumpeterian approach to learning when knowledge assets are shared. In this approach the following properties can be observed:

- Accumulation of knowledge only occurs within a specific *paradigm*
- Older knowledge is *destroyed* when paradigms are replaced with newer ones
- *Networks* of corroborative or competing knowledge assets exist that have their origin in the codification or abstraction processes
- The perception of the network of knowledge asset is the result of a *pattern* that is applied to the set of knowledge assets. Many different patterns can be applied to the knowledge basis
- Patterns are *discoverable* by human minds when they are observed.

The shared approach to learning does not rely on the power and strength of high quality well organised knowledge assets. The knowledge assets are generally not well developed and of such a good quality – the strength of this approach lies in the relationships that are formed when networks of knowledge assets are identified by the application of patterns. This approach is much more nimble and requires a harsh approach to dealing with knowledge that is outdated. The number of knowledge assets and the levels to which they are developed, are based on a fit for purpose approach and mitigating the risk that an organisation could be blindsided by the sheer amount of knowledge.

There is merit in both approaches to architecting knowledge assets. This research proposes that the enterprise architect needs to strike a balance between these approaches when architecting knowledge assets.

5.7 Relating knowledge asset architecture to EBA

The previous discussion regarding EBA (Enterprise Business Architecture, Section 3.3.1) has shown the areas of concern to business architecture to be amongst other subjects like organization structure, business goals and objectives, business functions, business services, business processes, business roles and business data models, collectively called *business dynamics*.

When one considers this list of items it becomes apparent that the focus of EBA is to architect areas of the business that can be described in the ordered regime. All the items are well understood in terms of meaning and content and are thus well codified or can be well codified.

The previous discussions regarding the I-Space (Section 4.9) have shown that there is significantly more to any organisation than what exists in the ordered regime. If the purpose of the architect is to drive an improved future state of the organisation in terms of profitability and ability to cope with a changing environment, then it only makes sense to ensure that the architecture of the business also includes the ability to deal with the complex and chaotic.

TOGAF[227] asserts that *the Business Architecture is also often necessary as a means of demonstrating the business value of subsequent Technical Architecture work to key*

[227] Harrison. 2007, p62

stakeholders, and the return on investment to those stakeholders from supporting and participating in the subsequent work.

Enterprise Architecture, according to Townson[228], drives among other things effectiveness and efficiency in the business. Business architecture acts like a mirror to the business in order to show what the business is currently doing and shows where improvements can be made through alignment and innovation. Business architecture thus acts as a change agent for business improvement and a way to ensure that business objectives, goals, roles, processes, functions and capabilities are well understood and that everyone in the business works toward the same goals.

This research suggests that understanding and alignment of knowledge assets is a critical part of driving effectiveness and efficiency in the business. Boisot[229] has shown, through the use of the evolutionary production function (See section 4.4), that knowledge assets are a source of competitive advantage for organisations. Yet maximising the value of those knowledge assets is not simple.

Boisot, MacMillan and Han claim that organisations are epistemologically different due to the following factors:

- The first factor is the fact that knowledge processing agent's circumstances will always differ from each other. That is because they will never be able to *occupy the same spatio-temporal location*. This results in the fact that *they cannot receive identical data with respect to an event.*[230] Culture, according to Boisot et al. *acts to filter out agent awareness of minor variations in context, and may in this way increase the agent's feelings that they share the same context allowing them to more effectively coordinate their actions*. [231] If enterprise architecture aims to drive effectiveness and efficiency in the organisation by aligning employees to a common vision, and the knowledge assets embedded in organisational culture is what knowledge agents use to derive common context through social sense making. Then it can be deduced that knowledge assets embedded within the elements described in the business architecture and other complex elements, like culture, should be included in the enterprise architecture of the organisation.

---

[228] Townson. 2008, p6
[229] Boisot. 1998
[230] Boisot et al. 2008, p94
[231] Boisot et al. 2008, p94

- The second factor refers to the knowledge processing agent's *cognitive style*[232]. Codification and abstraction, as discussed earlier, are methods used by knowledge processing agents to extract information from data which cause information to be of a *hypothetical* nature. This is because codification and abstraction cause the knowledge agent to conduct *acts of selection* subject to *refutation, revision, erasure and reformulation*. Each knowledge agent thus converts data into information based on its particular history and *cognitive preference and style*. This type of heterogeneity in knowledge processing agents cannot be eliminated but can be guided by conventions on what constitutes *legitimate hypotheses*. There are many ways for an architect to understand and guide this heterogeneity. An exhaustive list will not be provided here, but some suggestions are provided.

  In order to understand how different the hypotheses are that are formed, the architect/analyst can make use of methods like anecdote circles based on a specific and well-known event in the organisation's history. The different perspectives and viewpoints will emerge during such a session.

  Guiding the formulation of a hypothesis is much more difficult. The most direct way would be to write a policy telling people how to think about a certain matter. In fact that is exactly what policy statements are and even though they tend to stifle innovation due to their high level of codification and rigidity, they are sometimes necessary. Guidance can also be provided by more subtle means like providing knowledge bases where the collective meaning is documented, making use of mentoring programs or just allowing employees to freely discuss relevant subjects through a community of practice.

When an architect understands the intricacies of these types of behaviour causing heterogeneity in the organisation, he can better understand the effect that this might have on the technical implantation of the solution and lead the change management specialists better to handle issues regarding the problem that is being addressed.

Boisot, MacMillan and Han state that,

---

[232] Boisot et al. 2008, p95

> *….when two agents coordinate their actions, they do so on the basis of partially overlapping information and knowledge sets.* [233]

From a neoclassical point of view the focus has been on these overlapping sets of information and knowledge in order to establish a frictionless flow of knowledge and information. Even though this overlap is needed in an organisation it is the diversity of knowledge and information sets that drives innovation.

Boisot et al. write that,

> *….the high reliability of organisational processes does not come from epistemic homogeneity required for alignment alone, but also from having just the right amount of overlap between heterogeneous mindsets.* [234]

Knowledge asset architecture will allow the architect to drive the bigger picture in the organisation by striking a balance between creating overlapping knowledge and information sets and leveraging the heterogeneous aspects of the knowledge and information sets to drive innovation and prevent stagnation in the organisation in terms of innovation.

According to Boisot et al. the competitive advantage of an organisation can be maintained by,

> *….reframing faster than others to achieve a better fit between changing situations and their construal. Reframing is a form of adaptation to threats and opportunities that requires organisation agents to keep their tuneable filters well tuned.* [235]

5.8 Relating knowledge asset architecture with EIA

Enterprise Information Architecture (EIA) aims at providing the capability within the organisation to *flexibly share and exchange information assets to achieve effective enterprise change.* [236]

The relationship between the knowledge processing agent, data, knowledge and information as depicted in Figure 4-1 indicates how intrinsically the concepts are linked to each other.

Boisot et al. show that it is data that flows between knowledge processing agents. Data thus flows between systems and between people and between systems and people. It is only in the

---

[233] Boisot et al. 2008, p96
[234] Boisot et al. 2008, p97
[235] Boisot et al. 2008, p97
[236] Newman et al. 2008, p2

presence of knowledge that meaningful information can be extracted from the data, and it is only through the sense making process where the information is internalised into the agent where new knowledge can be created from the agent's perspective.

> *Information, therefore, far from being a thing, expresses a relationship between external data and a knowing agent.* [237]

Based on the above evidence, it can be concluded that EIA will be impossible without a proper and thorough understanding of what the organisation knows. Knowledge asset architecture will be an analysis of what the organisation knows, and should drive towards knowing in both the ordered, complex and chaotic regimes. Knowledge asset architecture, based on the above evidence, is emphatically linked to EIA.

5.9 Relating knowledge asset architecture to ETA

Technical information technology solutions are inherently knowledge agents that exist within the ordered regime of the organisation. An information system can be disassembled and re-assembled to its original state without long-term effects to the complete system. They do not deal well with complexity and require pre-defined rules on how to behave in certain conditions, human intervention is needed to make decisions for them in areas where unknown conditions exists.

Information technology solutions, however, operate within complex organisations and have become integral parts of organisations, driving communications, information flows, processes and managing critical organisational resources. Organisations' reliance on information systems have grown significantly and information systems are required more and more to assist the organisation in dealing with its complex environment. Information systems operate within these complex, sometimes chaotic environments all the time and the requirements for them to be resilient in the face to their environment become more prominent.

Knowledge assets, as previously discussed, are embedded within the objects found in the business and also affect knowledge assets embedded in other objects. Information systems are no exception to this rule. An information system reacts just like any other knowing agent as depicted in Figure 4-1. Data is received and internal knowledge (in the form of algorithms and rules) is applied, at which time the system makes decisions that produces information.

---

[237] Boisot et al. 2008, p95

It is the information technology revolution that, according to Boisot has *accelerated the rate of substitution of information for physical resources in human activity*. [238] The information technology revolution drastically increases the normal human capacity by several orders of magnitude to capture, process, transmit and store data.

Information technology, according to Boisot, brings a paradoxical, yet interesting problem, which enterprise architects need to solve when they plan systems:

- Information technology increases the organisation's ability to better codify, abstract and diffuse data. This means that it is more efficient to diffuse the same data to a larger audience.
- Information technology at the same time increases the ability to communicate more concrete and uncodified information over longer distances to a wider audience.

The enterprise architect will need to make the decision which of these types of data will dominate the solution that is addressing a specific problem. This decision will have a cultural effect on how knowledge assets and knowledge processing agents will react in the organisation, according to Boisot.

Highly codified and abstracted data will be favourable for audiences where there are lower levels of shared values among the knowledge processing agents. These types of transactions will be impersonal and may or may not have a wide audience depending on the amount of control that is placed on the data. Data needs to be tightly controlled in a bureaucratic culture where hierarchical relationships exist between the knowledge processing agents and roles will be well defined between superiors and subordinates. Less control is needed in areas where the environment is competitive as knowledge creation will likely be self-regulated.

Information less codified and more concrete should be destined for audiences where shared value systems are important and personal relationships exist between knowledge processing agents. Diffusion of information will be controlled in environments where roles are clearly defined in hierarchical structures working towards common goals. Less control over diffusion of information should be applied where there is no hierarchy of roles and the goals can be negotiated.

---

[238] Boisot. 1998, p208

The information systems planned by the ETA process will contain knowledge assets that need to be considered part of the architecture as they will influence aspects of the organisation. The enterprise architect needs to take into account cultural issues when data is transmitted to certain audiences, thereby creating a strong relationship between knowledge asset architecture and ETA.

5.10 Conclusion

Knowledge asset architecture represents a paradigm shift in the practice of enterprise architecture. It forces the enterprise architecture community to approach the proposed solutions from a different perspective than what the traditional approach requires. Knowledge asset architecture requires enterprise architecture to cultivate the organisation's knowledge assets in addition to providing a solution that fulfils the specified requirements only.

Cultivation of the organisation's knowledge assets will result in the strengthening the *fibre* of the organisation resulting in an organisation which is more resilient and agile. Well cultivated knowledge assets will strengthen the organisation because there exists a direct link between the knowledge assets and the activities (action) performed in the organisation. This means that the organisation will as a result be able to better cope with the unknown in its environment and be more innovative, allowing the organisation to distinguish itself better from its competitors.

Knowledge assets can be cultivated by for example creating processes in the EBA which bring people together so that they can share their experiences in order to collectively make better sense of their environment. A process which for instance creates a contract for the client can specifically contain as section where the sales team who engaged with the client and the service delivery team who serves similar customers can have an experience sharing session comparing the new customer and existing similar customers. The process then enables collective sensemaking of the requirements of the new customer, sharing pitfalls and opportunities which could result in a more customer focused contract which avoids some of the problems experienced with existing customers.

The result of such a process can have many benefits to organisation. Some of those benefits can be:

- To provide an opportunity for new team members to learn from team members with more experience.

- To bring people together to promote collective sensemaking thus increasing the synergistic properties of the knowledge assets which are used and created in the process.
- Over time it will naturally codify and abstract the knowledge assets used throughout the process resulting in a natural streamlining of the contracts placed by and organisation.
- It will also provide a forum where entrenched ideas and practices can continually be challenged to ensure the contracts which are being placed are in keep with the changing environment and responds to the customer needs.

The EIA domain can cultivate knowledge assets by tapping into the social or informal aspect of the organisation. A solution could for instance be put in place where all organisational content, whether they are contracts, policies, blogs, wikis or any other form of information can be tagged by users as a way of categorising similar content from his perspective. These tags can then be used in various ways within the organisation to create shared meaning. Some of the ways in which this share meaning can be used include:

- Exposing other people's tags to someone who is searching for similar information as a way of informing the searcher what content other people think are important.
- Using the tags as a type of barometer to see what areas in the organisation are important topics that gets a lot of attention from the users.
- Using the tags as a basis for an organisational dictionary where terminology is explained and linked to relevant content.
- The tags can become clusters of subject areas in the organisation which might emerge and provide insight to management on how to better structure and manage the organisation.

In the ETA domain the enterprise architects can cultivate knowledge assets by providing technologies which will assist any of the organisation's stakeholders to create and maintain links with other stakeholders or subject areas within the organisation, to easily access information relevant to them, to share such information with other people with whom they are connected and to easily keep tabs on people and subjects of interest. Enterprise architects will in this case need to think carefully about the structures and governance that needs to be put in place for such solutions. The right balance will need to be struck between providing a solution which will virally grow and flourish within the organisation, with just enough control to ensure that knowledge is relevant and useful and that the solution does not fall into a state of chaos.

Enterprise architects being responsible for many of the design elements in the organisation are well situated to gain and overview of the knowledge assets and the effect that they have on the organisation. Knowledge asset architecture will allow the enterprise architect to have a more balanced view of the ordered, complex and chaotic regimes in the organisation and the effect that it has over the different design elements that forms part of the other domains of the enterprise architecture.

Knowledge asset architecture does not introduce a completely new set of objects into the current enterprise architecture, but merely provides a different view on the objects that are currently being architected.

Knowledge assets form a strong relationship with Enterprise, Business, Information and Technical Architecture and already have a subconscious effect on these domains of the enterprise architecture. Explicitly cultivating knowledge assets performing enterprise architecture will result in people focused solutions that will naturally align with the organisation's goals and objectives but at the same time enable the organisation to be more robust and able to deal with crises and uncertainties through improved the shared meaning which disposes the organisation to collectively act in a beneficial manner.

The research findings are deemed sufficient to support the hypothesis that knowledge asset architecture significantly relates to EBA, EIA and ETA and that it should be deemed an integral part of management dynamics to derive value from information assets..

Bibliography

ALLEE V. 2002. A Value Network Approach for Modeling and Measuring Intangibles. [Online] Available: zotero://attachment/16357/, Accessed April 19, 2009.

ALLEE V. 2000. Reconfiguring the Value Network. *Journal of Business Strategy* 21: . [Online] Available: http://www.value-networks.com/Articles/Reconfiguring_the_Value_Network.pdf, Accessed April 19, 2009.

BOISOT M, A CANALS. 2008. Data, information and knowledge: have we got it right? *In* Explorations in information space, 15-47. Oxford University Press.

BOISOT M, IC MACMILLAN. 2008. Crossing epistemological boundaries: Managerial and entrepreneurial approaches to knowledge management. *In* Explorations in information space, 48-76. Oxford University Press.

BOISOT M, IC MACMILLAN, KS HAN. 2008. *Explorations in information space*. Oxford University Press.

BOISOT M, IC YAN. 2008. Codification, Abstraction, and Firm Differences: A Cognitive Information-based Perspective. *In* Explorations in information space, 77-108. Oxford University Press.

BOISOT MH. 1998. *Knowledge assets: Securing competitive advantage in the information economy*. Oxford University PressUS, New York. [Online] Available: www.oup.com.

BOOTH WC, GG COLOMB, JM WILLIAMS. 2008. *The Carft of Research*. Third Edition. The University of Chicago Press, Chicago.

BURTON. 2009. Link EA to Business Outcomes to Demonstrate Value. *Gartner*. [Online] Available: http://www.gartner.com/DisplayDocument?id=947612&ref=g_sitelink&ref=g_SiteLink, Accessed July 17, 2009.

BURTON B. 2008. Understand Enterprise Business Architecture to Realize Your Future State. *Gartner*. [Online] Available: http://my.gartner.com/portal/server.pt?open=512&objID=256&mode=2&PageID=2350940&docCode=158306&ref=docDisplay, Accessed August 4, 2009.

CASTELLS M. 2003a. *The Internet galaxy*. Oxford University Press.

CASTELLS M. 2003b. *The Rise of the Network Society*. John Wiley and Sons.

CILLIERS P. 1998. *Complexity and Postmodernism: Understanding Complex Systems*. 1st ed. Routledge.

COGNITIVE EDGE. 2007a. Method for Ancedote Circles. *Cognitive Edge Methods*. [Online] Available: http://www.cognitive-edge.com/methodprint.php?mid=41, Accessed January 5, 2010.

COGNITIVE EDGE. 2007b. The Future, Backwards. [Online] Available: http://www.cognitive-edge.com/method.php?mid=10, Accessed June 13, 2010.

COOPER MC, DM LAMBERT, JD PAGH. 1997. Supply Chain Management: More Than a New Name for Logistics. *The International Journal of Logistics Management* 8: 1-14.

CZARNIAWSKA-JOERGES B. 1992. *Exploring Complex Organizations: A Cultural Perspective*. Sage Publications, Inc.

EDMUNDS A, A MORRIS. 2000. The problem of information overload in business organisations: a review of the literature. *International Journal of Information Management* 20: 17-28.

FANG IE. 1997. *A history of mass communication*. Focal Press.

FIOL CM. 1991. Managing Culture as a Competitive Resource: An Identity-Based View of Sustainable Competitive Advantage. *Journal of Management* 17: 191.

FORSTER EM. 1909. *The Machine stops*. The Oxford and Cambridge Review.

GOVINDASAMY T. 2001. Successful implementation of e-Learning: Pedagogical considerations. *The Internet and Higher Education* 4: 287-299.

HARLAND CM. 1996. Supply Chain Management: Relationships, Chains and Networks. *British Journal of Management* 7: S63-S80.

HARRISON R. 2007. *TOGAF Version 8.1.1 Enterprise Edition*. Van Haren Publishing.

IYER B, RM GOTTLIEB. 2004. The Four-Domain Architecture: An approach to support enterprise architecture design. *IBM Systems Journal* 43: 587-597.

JOURDAN Z, RK RAINER, TE MARSHALL. 2008. Business Intelligence: An Analysis of the Literature. *Information Systems Management* 25: 121-131.

KALAKOTA R, M ROBINSON. 2001. *E-business 2.0*. Addison-Wesley.

KANTER RM. 2001. *Evolve!: succeeding in the digital culture of tomorrow*. Harvard Business Press.

KAPPELMAN L, R MCKEEMAN, L ZHANG. 2006. Early Warning Signs of it Project Failure: The Dominant Dozen. *Information Systems Management* 23: 31-36.

KURTZ C, D SNOWDEN. 2003. The new dynamics of strategy: Sense-making in a complex and complicated world. *IBM Ssystems Journal* 42: 462-483.

MARCH JG. 1994. *A Primer on decision making: How decisions happen*. The Free Press, New York.

MARCHAND DA, JD ROLLINS, WJ KETTINGER. 2001. *Information Orientation: The Link to Business Performance*. Oxford University Press.

MARKUS ML, C TANIS, PCV FENEMA. 2000. Enterprise resource planning: multisite ERP implementations. *Commun. ACM* 43: 42-46.

MERRIAM-WEBSTER. 2009a. Complex. *In* Merriam-Webster Online Dictionary, Merriam-Webster Online, [Online] Available: http://www.merriam-webster.com/dictionary/complex.

MERRIAM-WEBSTER. 2009b. Knowledge. *In* Merriam-Webster Online Dictionary, [Online] Available: http://www.merriam-webster.com/dictionary/knowledge.

MINTZBERG H, B AHLSTRAND, J LAMPEL. 2005. *Strategy safari: A guided tour through the wilds of strategic management*. Free Press.

MORGAN G. 1997. *Images of organization*. Sage Publications, Inc.

MUNSH V. 2002. Developing a technical architecture for Web-based enterprise software systems. *IBM Developer works*. [Online] Available: http://www.ibm.com/developerworks/web/library/wa-techarch/, Accessed August 23, 2009.

NEWMAN D, N GALL, A LAPKIN. 2008. Gartner Defines Enterprise Information Architecture. *Gartner*. [Online] Available: http://www.gartner.com/DisplayDocument?doc_cd=154071&ref=g_fromdoc, Accessed July 17, 2009.

NONAKA I, R TOYAMA, A NAGATA. 2000. A firm as a knowledge-creating entity: a new perspective on the theory of the firm. *Industrial and corporate change* 9: 1-20.

NONAKA I, R TOYAMA, N KONNO. 2000. SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation. *Long Range Planning* 33: 5-34.

OXFORD DICTIONARY. 2009. Knowledge. *In* Compactg Oxford English Dictionary, Oxford Press. [Online] Available: http://www.askoxford.com/concise_oed/knowledge?view=uk.

PAVLAK A. 2006. The EA value proposition.

PAYNE A, P FROW. 2005. A Strategic Framework for Customer Relationship Management. *Journal of Marketing* 69: 167-176.

PEPPARD J. 2000. Customer Relationship Management (CRM) in financial services. *European Management Journal* 18: 312-327.

PORTER ME, VE MILLAR. 1985. How information gives you competitive advantage. *Harvard business review* 63: 149–160.

REBENTISCH ES, M FERRETTI. 1995. A knowledge asset-based view of technology transfer in international joint ventures. *Journal of Engineering and Technology Management* 12: 1-25.

ROBERTSON B. 2008. Findings: Stop Concentrating on ETA! *Gartner*. [Online] Available: http://my.gartner.com/portal/server.pt?open=512&objID=256&mode=2&PageID=2350940&resId=790516&ref=Browse, Accessed August 23, 2009.

ROSS JW, P WEILL, D ROBERTSON. 2006. *Enterprise architecture as strategy*. Harvard Business Press.

SCHEKKERMAN J. 2003. *How to survive in the jungle of enterprise architecture frameworks*. Trafford Publishing.

SHANNON CE. 2001. A mathematical theory of communication. *SIGMOBILE Mob. Comput. Commun. Rev.* 5: 3-55.

SNOWDEN D. 2002. Complex acts of knowing: paradox and descriptive self-awareness. *Journal of Knowledge Management* 6: 100-111.

SOH C, SS KIEN, J TAY-YAP. 2000. Enterprise resource planning: cultural fits and misfits: is ERP a universal solution? *Commun. ACM* 43: 47-51.

STACEY R. 2001. *Complex responsive processes in organisations: Learning and Knowledge Creation*. Routledge, London.

STEWART TA. 2001. *The wealth of knowledge : intellectual capital and the twenty-first century organization*. Currency, New York.

TOWNSON S. 2008. Why does Enterprise Architecture Matter? [Online] Available: http://www.opengroup.org/onlinepubs/7699929399/toc.pdf, Accessed February 1, 2009.

UMBLE EJ, RR HAFT, MM UMBLE. 2003. Enterprise resource planning: Implementation procedures and critical success factors. *European Journal of Operational Research* 146: 241-257.

URBACZEWSKI L, S MRDALJ. 2006. A comparison of Enterprise Architecture Frameworks. *Issues in Information Systems* VII: 18-23.

WATSON H, B WIXOM. 2007. The Current State of Business Intelligence. *Computer* 40: 96-99.

WEICK KE. 1995. *Sensemaking in organizations*. Sage Publications, Inc.

WENGER E. 1999. *Communities of practice: learning, meaning, and identity*. Cambridge University Press.

ZACHMAN J. Enterprise Architecture: A Framework. [Online] Available: http://www.zifa.com/framework.html.

Zachman, John. "The Zachman Framework™ Evolution." http://www.zachmaninternational.com/index.php/ea-articles/100#maincol.

Zachman, John. "The Zachman Framework™: The Official Concise Definition," 2008. http://www.zachmaninternational.com/index.php/the-zachman-framework.

ZACHMAN JA. 2008b. The Zachman Enterprise Framework² ™. *Zachman Framework Associates*. [Online] Available: http://www.zachmanframeworkassociates.com/Standards/protected/framework-graphic-3, Accessed September 26, 2009.